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A new cryptic genus of terrestrial lizard (Gymnophthalmidae: Cercosaurinae) from the eastern Andes of central Peru

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Abstract. We describe a new terrestrial genus of the family Gymnophthalmidae, subfamily Cercosaurinae, from central Peru on the basis of genetic and morphological characters. The monotypic *Wilsonosaura* gen. n. can be distinguished morphologically from all other genera of Cercosaurinae except of *Proctoporus* by having lower palpebral disc semi-transparent and undivided, dorsal scales weakly keeled to smooth, lateral scales distinctly smaller than dorsal scales, lateral scales forming a distinct longitudinal line of smaller scales, and absence of distinctly enlarged gulars. *Wilsonosaura* gen. n. can be distinguished from most species of *Proctoporus* by following characters: frequent occurrence of prefrontal shields, presence of weakly keeled to nearly smooth dorsal scales, by having a continuous line of lateral scales at the middle of flanks occasionally widened vertically by additional lateral scales interspacing the dorsals. Nevertheless, an unambiguous morphological character distinguishing the new genus from *Proctoporus* has not been identified. Phenotypic synapomorphies are not known for the new genus. In previously published phylogenies, *Wilsonosaura* gen. n. was identified as a distinct clade separated from all other cercosaurines. *Wilsonosaura* gen. n. is distributed in the regions of Junín, Pasco, and Huancavelica in upper montane forests and puna habitats from 2400 to 3726 m a.s.l. of the eastern Andes. We transfer *Euspondylus josyi* Köhler, 2003 as designated type species to *Wilsonosaura* gen. n. as *Wilsonosaura josyi* (Köhler, 2003) comb. n. and update the species diagnosis, description, and distribution.

Key words. Squamata, taxonomy, systematics, phylogeny, morphology, cryptic genus, *Wilsonosaura* gen. n., *Euspondylus josyi,* new combination.

Resumen. Describimos un nuevo género de lagartija de la familia Gymnophthalmidae, subfamilia Cercosaurinae, del centro del Perú, usando caracteres moleculares y morfológicos. *Wilsonosaura* gen. n. se puede distinguir morfológicamente de todos los demás géneros de Cercosaurinae excepto *Proctoporus* por tener un disco palpebral inferior semi-transparente y no dividido, escamas dorsales ligeramente quilladas a lisas, escamas laterales notoriamente más pequeñas que las escamas dorsales, escamas laterales formando una línea longitudinal distinta a lo largo del cuerpo y ausencia de escamas gulares notoriamente grandes. Se puede diferenciar *Wilsonosaura* gen. n. de la mayoría de especies de *Proctoporus* mediante los siguientes caracteres: presencia frecuente de placas prefrontales, presencia de escamas dorsales ligeramente quilladas a lisas, presencia de una línea continua de escamas laterales en el medio de los flancos (ocasionalmente más ancha en aspecto vertical debido a la presencia de escamas laterales junto a las dorsales). Sin embargo, no se ha identificado un carácter morfológico inequívoco que distinga al nuevo género de *Proctoporus*. No se conocen sinapomorfías fenotípicas para el nuevo género. En una filogenia previamente publicada, *Wilsonosaura* gen. n. fue identificado como un clado distinto separado de todos los demás cercosaurinos. *Wilsonosaura* gen. n. está distribuido en las regiones de Junín, Pasco y Huancavelica, en los Andes orientales, y habita bosques montanos y puna a elevaciones entre 2400 y 3726 m s.n.m. Transferimos *Euspondylus josyi* Köhler, 2003 y la designamos como especie tipo de *Wilsonosaura* gen. n., como *Wilsonosaura josyi* (Köhler, 2003) comb. n. y actualizamos la diagnosis, descripción y distribución de esta especie.

Palabras clave: Squamata, taxonomía, sistemática, filogenia, morfología, género críptico, *Wilsonosaura* gen. n., *Euspondylus josyi*, nueva combinación

Introduction

Currently, 257 species of lizards of the family Gymnophthalmidae are allocated in 54 genera, which are distributed widely across Central and South America (Uetz et al. 2019, Vásquez-Restrepo et al. 2019). Fifteen genera and 60 species of gymnophthalmids are known to live in Peru (Uetz et al. 2019). The taxonomy of gymnophthalmids remains complicated because morphological similarities and convergences hinder generic allocation of species (e.g., Kizirian 1996, Köhler & Lehr 2004, Chávez et al. 2011). Extensive herpetological fieldwork in the eastern Andes of central Peru over the past years by us has led to the discovery of many new gymnophthalmid lizards. Among them were two new arboreal genera that have been recently described following an integrative approach of taxonomy: *Selvasaura brava* Moravec, Šmíd, Štundl & Lehr, 2018, and *Dendrosauridion yanesha* Lehr, Moravec, Lundberg, Köhler, Catenazzi & Šmíd, 2019. Furthermore, Moravec et al. (2018) and Lehr et al. (2019) presented molecular phylogenetic analyses justifying the generic status of *Dendrosauridion, Selvasaura,* and one additional genus (this paper).

Herein, we provide a formal morphological description of a new genus of terrestrial gymnophthalmid from upper montane forests and puna of the eastern Andes of central Peru (Fig. 1) that was recognized as Unnamed clade II or Cercosaurini clade 2 in previous large-scale phylogenetic revisions by Torres-Carvajal et al. (2016), Moravec et al. (2018), Lehr et al. (2019), and Vásquez-Restrepo et al. (2019).

Materials and methods

Characters

We followed the format of the descriptions and terminology of morphological characters used in previous studies such as Oftedal (1974), Doan & Castoe (2003), Chávez et al. (2017), Sánchez-Pacheco et al. (2017a, b), and Moravec et al. (2018). Specimens were fixed in 96% ethanol and stored in 70% ethanol. Sex and maturity of specimens were identified through sexual dimorphic characters (size, femoral pores) or by dissections to evaluate the gonads. Specimens with SVL 40.7 mm and below were considered juveniles. The following metric characters were taken using a digital caliper and dissecting microscope: snout–vent length (SVL) – distance from the snout tip to cloaca; tail length (TL) – distance from cloaca to the tail tip, if original, if regenerated indicated by measurement in parenthesis; head length (HL) – distance from the snout tip to the angle of jaw; head width (HW) – greatest width of the head; head depth (HD) – greatest depth of the head; eye–nose distance (E–N) – straight distance from the snout tip to anterior corner of eye; forelimb length (FLL) – from axilla to tip of distal claw; hind limb length (HLL) from groin to tip of distal claw; axilla–groin distance (AGD) – distance between limbs (left/right). All examined characters were measured to the nearest 0.1 mm.

We evaluated meristic and qualitative pholidotic characters as follows: number of supralabials – from the rostral to the mouth corner, last labial defined by its considerably larger size compared with the posteriorly adjacent shields; postparietals – number of enlarged shields attaching posterior margin of parietals and interparietal; prefrontals – presence or absence of prefrontal shields; nasal shields – undivided or partially divided; loreal shield – presence or absence of separate loreal; genial scales – number of pairs, number of pairs in contact; gular scales – number of gulars in a straight median series; collar scales – number of enlarged scales in collar; dorsal scales – number of transverse rows of dorsal scales from the third row behind the interparietal to the level of the rear edge of the hind limb; lateral scales – number of considerably smaller scales situated between larger dorsal and ventral scales at middle of flanks (left/right); scales around midbody; ventral scales – number of transverse rows of ventral scales; ventrals across midbody – number of longitudinal rows of ventral scales; preanal plates – number of large plates in the anterior row and posterior row of preanal scales (separated by a plus symbol); number of lamellae under Finger IV – number of single and divided lamellae (left/right), lamella divided into segments counted as one individual lamella; number of

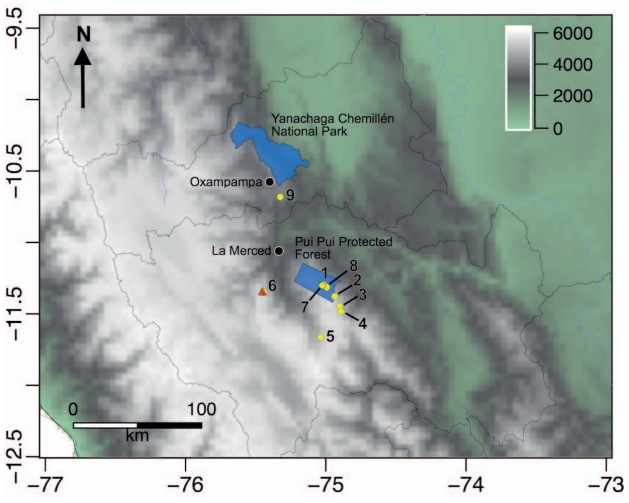

Figure 1. Map of central Peru with type locality of *Wilsonosaura josyi* gen. n. et comb. n. and new collecting sites. Type locality of *Euspondylus josyi* (Region Junín, Maraynioc, 2880 m a.s.l.) is indicated by a red triangle. New collecting sites: 1: Pui Pui Protected Forest at Trancapampa, 3550 m a.s.l.; 2: Pui Pui Protected Forest, Quebrada Tarhuish, left bank of Antuyo River, "Tinqu", 3555 m a.s.l.; 3: Tasta, forest patch near Evaristo's house, 3609 m a.s.l.; 4: Sector Carrizal, Carrtera Satipo-Toldopampa, km 134, 3350 m a.s.l.; 5: right slope near road leading to Satipo, 3726 m a.s.l.; 6: Maraynioc, 200 m downhill, 3504 m a.s.l.; 7: Pui Pui Protected Forest at Hatunpata, 3710 m a.s.l.; 8: Pui Pui Protected Forest at Antuyo Bajo, 3400 m a.s.l.; 9: Bosque de Sho'llet, 2430 m a.s.l. Map by R. von May.

lamellae under Toe IV – number of single and divided lamellae (left/right, lamella divided into segments counted as one individual lamella); femoral pores – total number and number per hind leg (left/right). Tongue terminology follows Harris (1985).

Notes on the coloration in life were taken from field notes and photographs. Collection acronyms are FMNH= The Field Museum of Natural History, Chicago, USA; MCZ = Museum of Comparative Zoology, Cambridge, USA; MUSM = Museo de Historia Natural Universidad Nacional Mayor de San Marcos, Lima, Peru; NMP-P6V = National Museum, Prague, Czech Republic; UMMZ = University of Michigan Museum of Zoology. Field number codes are IWU = Illinois Wesleyan University. For comparative material examined see appendix. Threat status was evaluated using the IUCN criteria (2012). The map was done with the R package maptools (Bivand & Lewin-Koh 2014) by R. von May.

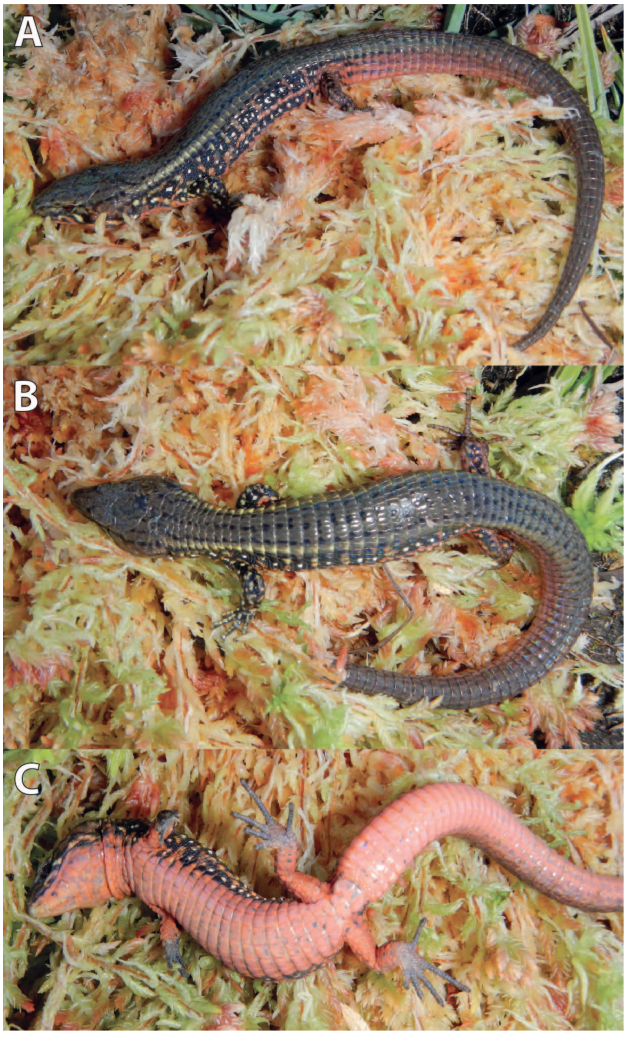

Figure 2. Life male *Wilsonosaura josyi* gen. n. et comb. n. (MUSM 31978, SVL 60.9 mm) in dorsolateral (A), dorsal (B), and ventral (C) views. Photos by E. Lehr.

Nomenclatural acts

The electronic edition of this article conforms to the requirements of the amended International Code of Zoological Nomenclature, and hence the new names contained herein are available under that Code from the electronic edition of this article. This published work and the nomenclatural acts it contains have been registered in ZooBank, the online registration system for the ICZN. The LSID (Life Science Identifier) for this publication is: urn:lsid:zoobank.org:pub:D3CE80B0-5DCB-40AD-AE15-646604254F41. The electronic edition of this work was published in a journal with an ISSN, and has been archived and is available from the following digital repositories: www.salamandra-journal.com.

Results

In previously published phylogenies (Torres-Carvajal et al. 2016, Moravec et al. 2018, Lehr et al. 2019, Vásquez-Restrepo et al. 2019) a distinct clade (Unnamed clade II or Cercosaurini clade 2) separated from all other cercosaurine genera was identified. This clade includes specimens that were collected at the type locality of *Euspondylus josyi* Köhler, 2003. Comparisons of our newly collected material (five specimens) at the type locality of *E. josyi* with published data for 40 adult type specimens of *E. josyi,* and six examined paratypes confirmed that *E. josyi* belongs to this unnamed clade. In the following, we describe Unnamed clade II (Cercosaurini clade 2 according to Vásquez-Restrepo et al. 2019) as a new genus (e.g., Fig. 2) to which we designate *E. josyi* as type species.

Family Gymnophthalmidae Fitzinger, 1826
Subfamily Cercosaurinae Gray, 1838
Genus *Wilsonosaura* gen. n.

(Figs 2–9, Tables 1–3)

Type species: *Euspondylus josyi* Köhler, 2003.
Suggested English name: Wilson's microtegu.

ZooBank LSID: urn:lsid:zoobank.org:pub:D3CE80B0-5DCB-40AD-AE15-646604254F41
Unnamed clade II (Torres-Carvajal et al. 2016, Moravec et al. 2018, Lehr et al. 2019)
Cercosaurini clade 2 (Vásquez-Restrepo et al. 2019)

Content: one species: *Wilsonosaura josyi* (Köhler, 2003) comb. n. (previously *Euspondylus josyi* Köhler, 2003).

Diagnosis: Phenotypic synapomorphies are not known for this genus. Morphologically, *Wilsonosaura* gen. n. can be distinguished from all other genera of Cercosaurinae (except *Proctoporus*) by the combination of the following characters: lower palpebral disc semi-transparent, undivided (divided in *Anadia, Andinosaura, Centrosaura, Euspondylus, Gelanesaurus, Oreosaurus, Petracola, Rheo-*

saurus, Riama, and most *Placosoma* species; opaque in *Pholidobolus*); dorsal scales homogenous (heterogenous in *Centrosaura, Echinosaura, Gelanesaurus, Neusticurus, Potamites, Rheosaurus*; minute tubercles on posterior dorsal scales in *Placosoma;* slightly rugose in *Selvasaura*); lateral scales distinctly smaller than dorsal scales (lateral scales not distinctly reduced in size in *Macropholidus*); lateral scales forming a distinct longitudinal line of smaller scales (irregular pattern of smaller laterals in *Dendrosauridion*), dorsal scales weakly keeled to nearly smooth (smooth dorsal keels in *Dendrosauridion*), and short snout bluntly rounded (moderately long snout pointed in *Dendrosauridion*); absence of distinctly enlarged gulars (medial gulars distinctly enlarged forming longitudinal rows in *Cercosaura*). Frequent occurrence of prefrontal shields, presence of weakly keeled to nearly smooth dorsal scales, and a continuous line of lateral scales at the middle of flanks being occasionally widened vertically by additional lateral scales interspacing the dorsals distinguish *Wilsonosaura* gen. n. from most species of *Proctoporus*. Nevertheless, an unambiguous morphological character distinguishing the new genus from *Proctoporus* has not been identified (see e.g., Oftedal 1974, Cadle & Chuna 1995, Altamirano-Benavides et al. 2013, Kok et al. 2013, Torres-Carvajal & Mafla-Endara 2013, Echevarría et al. 2015, Borges-Nojosa et al. 2016, Chávez et al. 2017, Sánchez-Pacheco et al. 2017b, Moravec et al. 2018, Lehr et al. 2019).

Genetically, *Wilsonosaura* gen. n. is identified as a distinct clade separated from other cercosaurines (Torres-Carvajal et al. 2016, Moravec et al. 2018, Lehr et al. 2019, Vásquez-Restrepo et al. 2019).

Definition: (1) head shields smooth (Figs 3A, B); (2) frontoparietal and parietal shields paired; (3) frontonasal, frontal and interparietal shields single; (4) prefrontal shields present or absent; (5) lower palpebral disc semi-transparent, undivided; (6) loreal shield present or absent; (7) scale organs on labials present; (8) anterior-most supraocular and anterior-most superciliary shields fused; (9) dorsal surface of the tongue covered by scale-like papillae (except of bifurcated distal part), ventral surface with 6–8 distinct infralingual plicae; (10) nuchal scales smooth; (11) dorsal scales rectangular, weakly keeled to nearly smooth, slightly subimbricate or juxtaposed; (12) scales on tail weakly keeled to smooth dorsally, smooth ventrally; (13) lateral scales smaller than dorsals, forming a continuous line of one to four scales at the middle of flanks, occasionally widened vertically by additional lateral scales interspacing the dorsals (Fig. 3D); (14) ventral scales squared, smooth, juxtaposed; (15) limbs pentadactyl, digits clawed; (15) 11–19 femoral pores in males, 4–15 in females; (16) upper and lower jaws bearing bicuspid teeth.

Distribution: Peru: Regions of Huancavelica (Torres-Carvajal et al. 2016), Junín, and Pasco in upper montane forests and puna habitats between 2430 and 3710 m a.s.l. (Fig. 1).

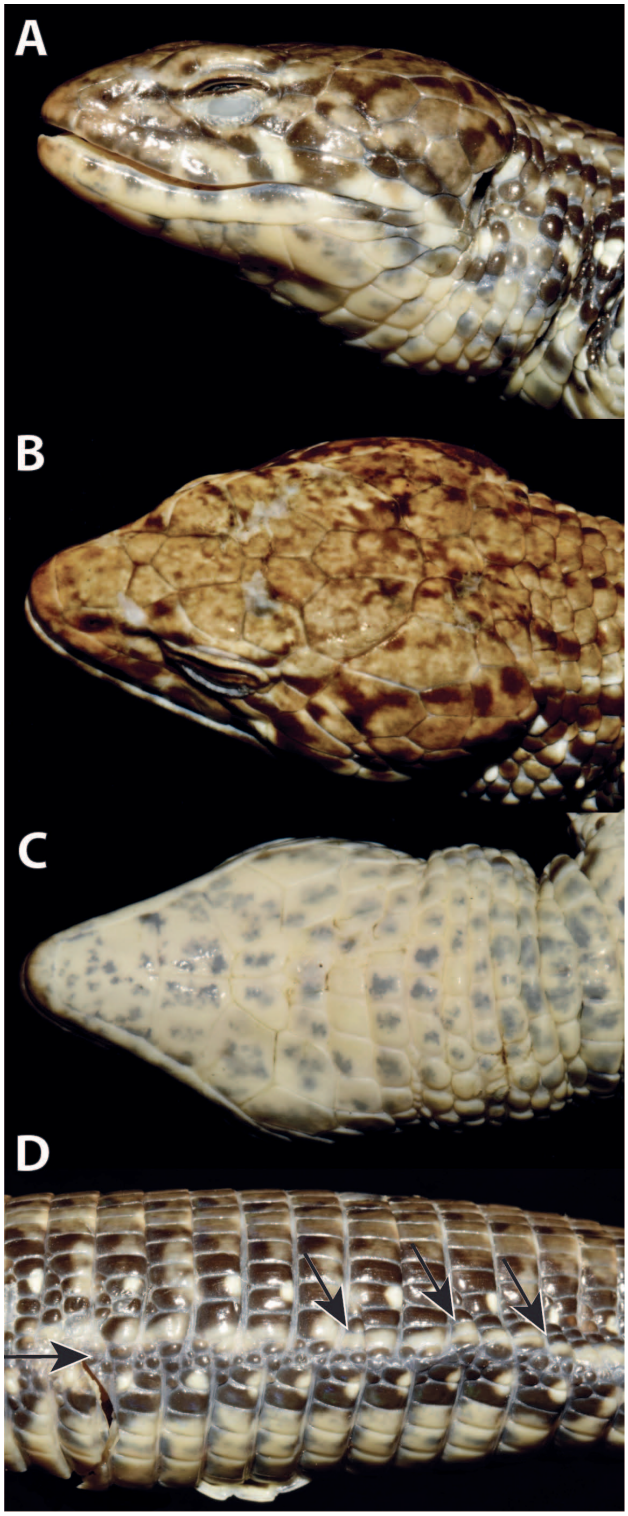

Figure 3. Scutellation of head and flank of *Wilsonosaura josyi* gen. n. et comb. n. (MUSM 31978). Head in lateral (A), dorsal (B), ventral (C), and left flank (D) in lateral views. The horizontal arrow indicates the continuous line of laterals, diagonal arrows indicate occasionally widened areas by scales interspacing the dorsals. Photos by J. Moravec.

Etymology: The generic name *Wilsonosaura* is derived from the last name Wilson and the Greek noun *σαύρα* (lizard; *saura* is the feminine form). We dedicate the new genus to Dr. E. O. Wilson in recognition of his lifelong contributions to biodiversity research and conservation.

Wilsonosaura josyi (Köhler, 2003) comb. n.

(Figs 2–9, Tables 1–3)

Systematic remarks: *Euspondylus josyi* was described by Köhler (2003) based on 40 specimens (20 males, 20 females) collected in the Region Junín (Maraiyioc [incorrectly spelled, Maraynioc according to Paz Soldan 1877], 11°22' S, 75°24' W, 2880 m a.s.l.) by J.A. Griswold in 1939. Based on its undivided palpebral disc and our molecular data (Moravec et al. 2018) including specimens from the type locality of *E. josyi* we consider the generic affiliation of *Euspondylus josyi* incorrect. In addition, the examination of our newly collected material revealed the following discrepancies: Köhler (2003) described the dorsals as keeled, however, according to the six examined paratypes and our newly collected material they are weakly keeled to smooth. Köhler (2003) noted that in preservative "all specimens in the type series have uniform dark olive brown dorsal and lateral surfaces of head, body, tail and limbs without lateral ocelli which does not appear to be an artifact of preservation". However, we noted distinct lateral ocelli (white spots on black blotches) in two males (MCZ 85780, 85782) and tiny lateral white spots in two males (MCZ 85732, 85762) and one female (MCZ 85779) in the six paratypes we examined.

Amended diagnosis (sample size refers to the newly collected specimens): A small gymnophthalmid (max SVL 62.0 mm in adult males, max SVL 56.1 mm in adult females), which can be characterized by the following combination of characters: 1) body moderately robust, slightly depressed; 2) head bluntly rounded, longer than wide (HL/HW 1.23–1.63 in males, 1.30–1.68 in females), conspicuously wider than neck; 3) ear opening distinct, deeply recessed; 4) nasals separated by undivided frontonasal; 5) frontal, frontoparietals, parietals, postparietals and interparietal present, prefrontals (present or absent); 6) parietals slightly longer than wide; 7) supraoculars three (exceptionally four according to Köhler 2003), anterior-most supraocular fused with anterior-most superciliar; 8) superciliar series usually complete, consisting of four shields, anterior-most superciliar fused with anterior-most supraocular; 9) nasal undivided or partially divided; 10) loreal absent (fused with nasal) or present; 11) supralabials 5–7; 12) genials in four pairs [wrongly two pairs according to Köhler 2003], first and second pair in contact; 13) collar present, containing 8–10 enlarged scales; 14) dorsal scales in 32–37 transverse rows in males (N = 9), 31–34 transverse rows in females (N = 4), [29–35 transverse rows combined for both sexes in Köhler 2003], rectangular, weakly keeled to nearly smooth (keeled according to Köhler 2003), slightly subimbricate or juxtaposed; 15) ventral scales in 17–22 transverse rows in males (N = 9), 17–20 in females (N = 4), [16–19 transverse rows combined for both sexes in Köhler 2003], squared, smooth, juxtaposed; 16) scales around midbody 32–39 in males (N = 9), 36–42 in females (N = 4), [31–37 scales combined for both sexes in Köhler 2003]; 17) lateral scales smaller than dorsal scales, forming a continuous line of one to four scales at the middle of flanks occasionally widened vertically up to seven by additional lateral scales interspacing the dorsal scales (Fig. 3D); 18) limbs pentadactyl, all digits clawed, forelimb reaching anteriorly to fourth supralabial; 19) subdigital lamellae under Finger IV 10–14, under Toe IV 14–20; 20) femoral pores in males 11–19, in females 2–15; 21) 4–9 preanal plates (2–3 anterior preanal scales + 2–6 posterior preanal scales); 22) tail 1.2–1.5 times longer than SVL in males, 1.2–1.4 in females; 23) caudals dorsally rectangular, weakly keeled to smooth, and subimbricate, ventrally squared, smooth, and juxtaposed; 24) lower palpebral disc oval, semi-transparent, undivided; (24) dorsal surface of the tongue covered by scale-like papillae (except of bifurcated distal part), ventral surface with 6–8 distinct infralingual plicae (N = 5); 26) in life, dorsal ground coloration of head, body, and tail olive brown, olive green or reddish brown with an iridescent shining depending on light incidence; body and tail dorsally usually with three narrow longitudinal black irregular stripes (one dorsolaterally on each side and one middorsally), black irregular dorsolateral stripes bordered at outer margin with a distinct (1–2 scales wide) dorsolateral stripe (yellowish green, tan, greyish olive or pale reddish brown) longitudinally from neck to midbody bordered by a narrow black stripe on its outer margin or bordered by the darker flank ground coloration; flanks are black and salmon mottled with few yellowish-tan flecks, olive brown, greyish brown or predominately olive green; flanks with few to many white flecks surrounded by black forming ocelli (absent according to Köhler 2003, however, in five examined paratypes present); ventral coloration ranges from greyish green, yellowish green in females, and salmon, orange to red in males; a bright stripe (white, yellowish tan, yellowish green or red) from ventral margin of eye across subocular and supralabials bordered by black is present; iris is pale brownish orange to red.

Wilsonosaura josyi comb. n. can be distinguished from the following gymnophthalmids known from the Selva Central (regions of Pasco and Junín) in central Peru (characters of *W. josyi* comb. n. in parenthesis): *Euspondylus excelsum* Chávez, Catenazzi & Venegas, 2017 from the eastern Andes up to 1550 m a.s.l. is partially arboreal (terrestrial) and has a SVL up to 90.1 mm (62.0 mm), Lehr et al. (2018). *Euspondylus paxcorpus* Doan & Adams, 2015 has an undivided palpebral disc. Following Chávez et al. (2017), *Euspondylus* is characterized by a divided palpebral disc. Therefore, the generic placement of *Euspondylus paxcorpus* Doan & Adams, 2015 is incorrect. According to its external morphology, *"Euspondylus" paxcorpus* belongs to either *Proctoporus* or *Wilsonosaura* gen. n. However, in the absence of genetic data for *"E." paxcorpus* we cannot determine whether this taxon belongs

to *Proctoporus* or *Wilsonosaura* gen. n. *"Euspondylus" paxcorpus* from the Ulcumayo District (Region Junín) at 3280–3754 m a.s.l. (Doan & Adams 2015) has prefrontals (absent or present), four supraoculars (three), dorsal scales with a low rounded keel (weakly keeled to nearly smooth), longitudinal dorsal count 40–45 (29–35), ventral rows in a transverse count 16–22 (23–25), femoral pores in males 16–24 (11–19), in females 10–18 (4–15), and no sexual dimorphism in coloration (males have venter salmon, orange to red vs females have venter greyish green or yellowish green). *Proctoporus pachyurus* Tschudi, 1845 has four supraoculars (three), Mamani et al. (2015). *Selvasaura brava* Moravec, Šmid, Štundl & Lehr, 2018 is arboreal (terrestrial), and has an SVL up to 45.9 mm (62.0 mm), Moravec et al. (2018).

Hemipenial morphology (Fig. 4): The hemipenes of NMP-P6V 75084 were everted during preservation and fixed in alcohol. The completely everted organs measure approximately 6.7 mm. The hemipenial body has a conical shape with the proximal region distinctly thinner than the distal region. The hemipenial lobes are narrow, indistinct from the hemipenial body and do not possess filiform appendages. The flounces on the asulcate side (Fig. 4A) form two discontinuous series (central vertex absent, asulcate central area broad) of about 12 lines expanding on the lateral sides and the apex of the hemipenial body. Five most distal flounces covering the apical region (Fig. 4B) are chevron-shaped and interrupted centrally. There are four less distinct isolated horizontal flounces on the proximal-central region of the asulcate side. Flounce ornamentation consists of subtle, barely visible transversal ribs. The sulcus spermaticus begins at the hemipenial base and proceeds in a straight central line towards the apex. It is edged by wide lateral fleshy nude labia-form area covering distally the area of the lobular division. The sulcus spermaticus terminates in the apical area of the hemipenis among the two small hemipenial lobes and an individual slightly smaller lobe-like structure bordering proximally the area of the lobular division.

Variation: Measurements and scutellation data are given in Tables 1–3. *Wilsonosaura josyi* comb. n. has a pronounced sexual coloration dimorphism with males having the venter salmon, orange or red (Figs 2C; 5B, D, F), whereas females have the venter greyish green to yellowish green (Figs 6B, D). Furthermore, males have usually more ocelli on the flanks than females. Males have more femoral pores than females.

Two adults (male MUSM 31160, Fig. 5A; female MUSM 31188, Fig. 6A) have the dorsum predominately olive green and one juvenile (NMP-P6V 75085, Fig. 7C) reddish brown. All specimens have the contrasting pale dorsolateral stripe of varying coloration (yellowish green in male MUSM 31991, Fig. 5E; and female MUSM 31188, Fig. 6A; tan in male NMP-P6V 75867, Fig. 5C; pale greyish brown in female MUSM 31973, Fig. 6C; greyish olive in male MUSM 31160, Fig. 5A; pale reddish brown in juve-

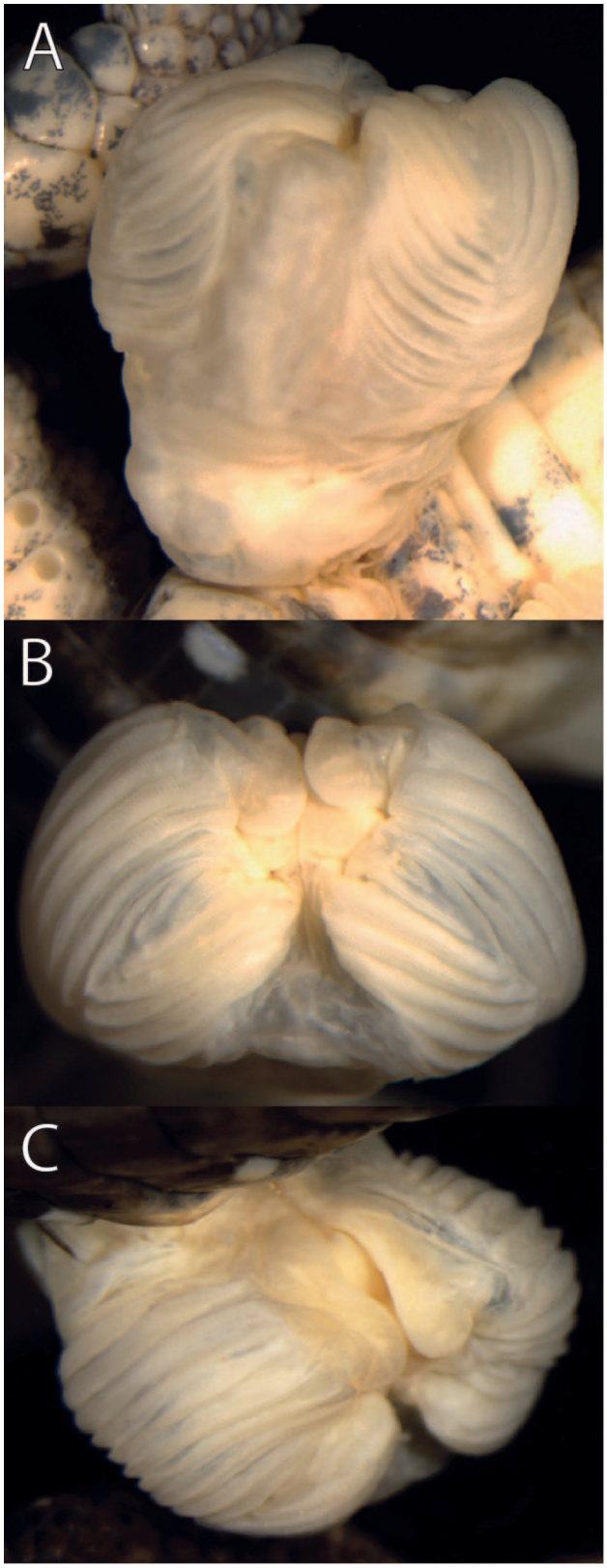

Figure 4. Hemipenis of *Wilsonosaura josyi* gen. n. et comb. n. (NMP-P6V 75084) in asulcate (A), apical (B), and sulcate (C) views. Photos by J. Moravec.

niles MUSM 31127, NMP-P6V 75086, Figs 7A, C) longitudinally from neck to midbody bordered by a narrow black stripe (males NMP-P6V 75867, MUSM 31160, 31991, Fig. 5; females MUSM 31188, 31973, Fig. 6; juvenile MUSM 31127, Fig. 7A) on its outer margin or bordered by the darker flank ground coloration (greyish brown in juvenile NMP-P6V 75085, Fig. 7C). The flanks are as described above but with varying ground coloration. One male (MUSM 31160, Fig. 5A) and one female (MUSM 31188, Fig. 6A) have the flanks predominately olive green. Ocelli on the flanks are present in varying numbers. Some males (MUSM 31978, Fig. 2; NMP-P6V 75867, MUSM 31991, Figs 5C, E) have the flanks with numerous ocelli whereas other males (MUSM 31160, Fig. 5A) and females (MUSM 31188, Fig. 6A) have very few; least ocelli are present in juveniles (MUSM 31127, Fig. 7A; NMP-P6V 75085, Fig. 7C). Ventral coloration ranges from greyish green (female MUSM 31973, Fig. 6D), yellowish green (female MUSM 31973, Fig 6B; juvenile NMP-P6V 75085, Fig. 7B), salmon (male MUSM 31978, Fig 2C; juvenile NMP-P6V 750857, Fig. 7D), orange (male NMP-P6V 75867, Fig. 5D; male MUSM 31991, Fig. 5F) to red (male MUSM 31160, Fig. 5B). A bright stripe from ventral margin of eye across subocular and supralabials bordered by black is present in varying coloration (white in males NMP-P6V 75867, MUSM 31991, Figs 5C, E; yellowish-tan in juveniles MUSM 31127, NMP-P6V 75085, Figs 7A, C; yellowish green in females MUSM 31188, MUSM 31973, Figs 6A, C; red in male MUSM 31160, Fig. 5A). The iris coloration varies between pale brownish orange (e.g., Figs 5A, C; 6, 7) to red (Figs 2; 5B). All specimens show an iridescent shining on the head, body, and tail depending on light incidence (e.g., males MUSM 31160, 31991, Figs 5A, E).

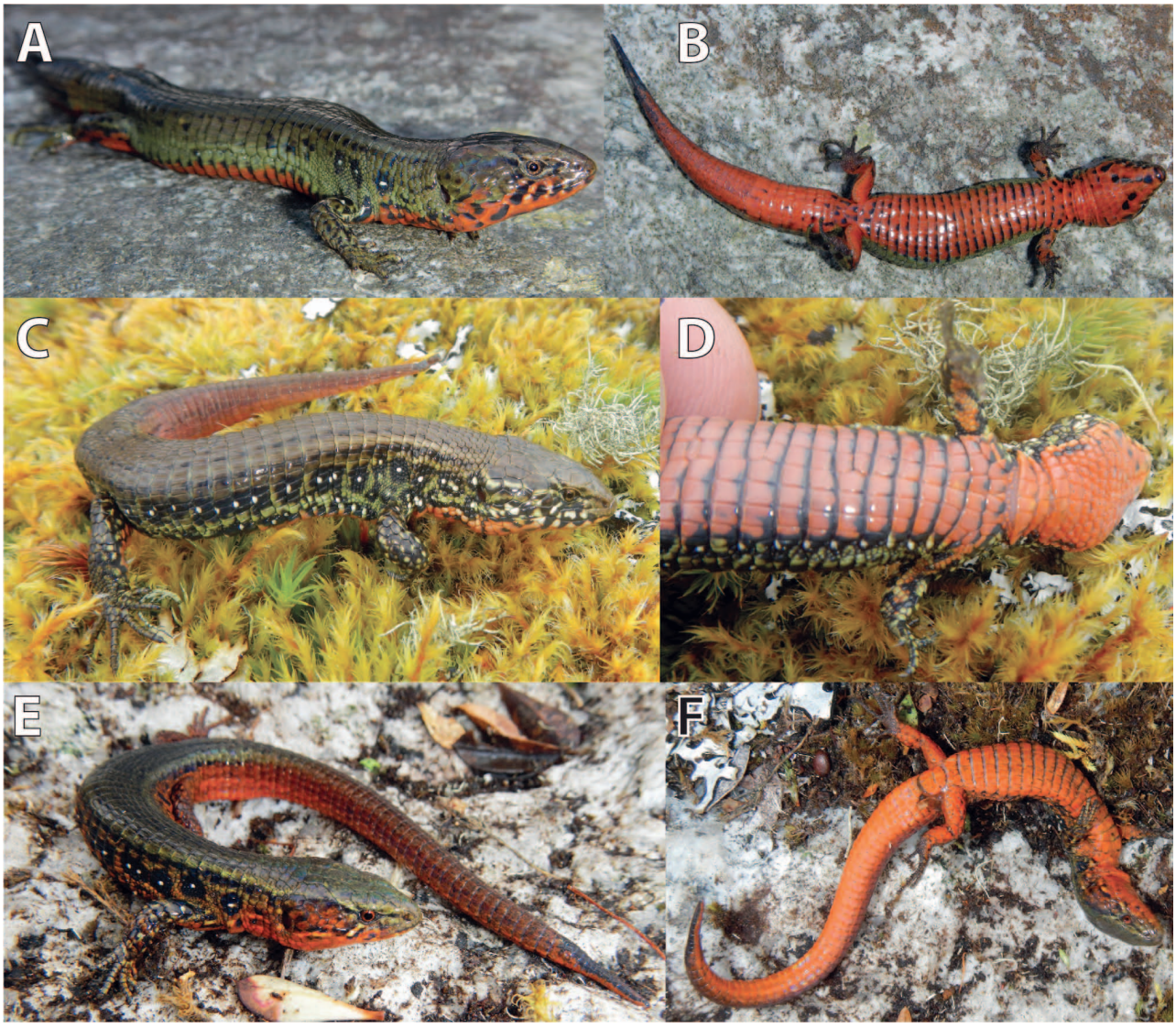

Figure 5. Life males of *Wilsonosaura josyi* gen. n. et comb. n. in dorsolateral and ventral views. MUSM 31160, SVL = 53.6 mm (A, B), NMP-P6V 75867, SVL = 59.6 mm (C, D), MUSM 31991, SVL = 58.7 mm (E, F). Photos by E. Lehr.

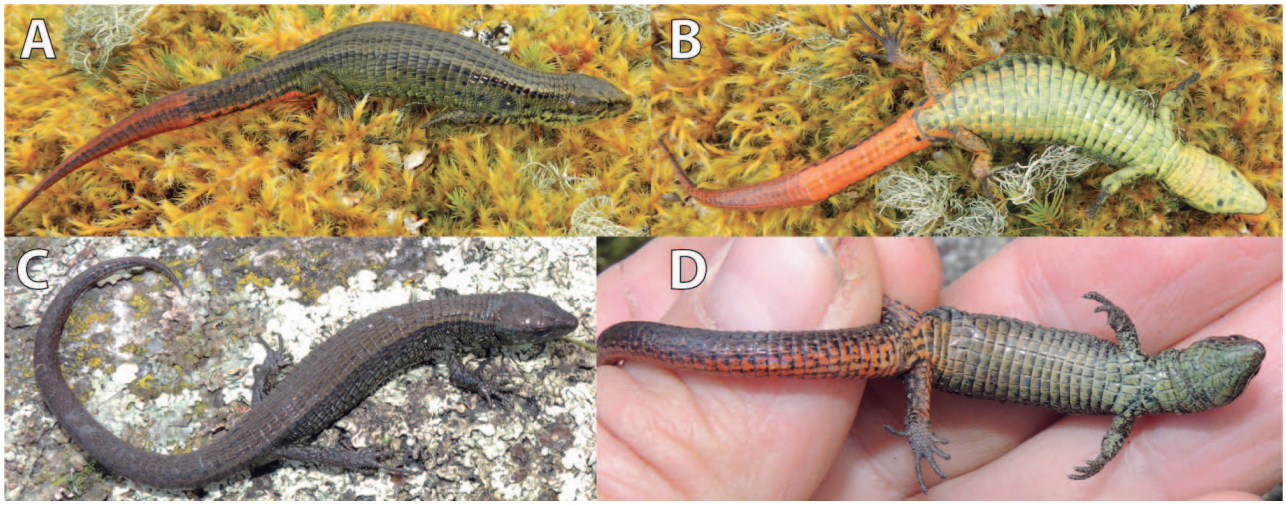

Figure 6. Life females of *Wilsonosaura josyi* gen. n. et comb. n. in dorsolateral and ventral views. MUSM 31188, SVL = 56.1 mm (A, B), MUSM 31973, SVL 48.7 mm (C, D). Photos by E. Lehr (A, B) and J. Moravec (C, D).

Figure 7. Life juveniles of *Wilsonosaura josyi* gen. n. et comb. n. in dorsolateral and ventral views. MUSM 31127, SVL 35.3 mm (A, B), NMP-P6V 75085, SVL = 25.6 mm (C, D). Photos by E. Lehr.

Table 1. Measurements (in mm) and pholidotic characters of adult males of *Wilsonosaura josyi* gen. n. et comb. n. A plus sign indicates the presence of a character, a dash indicates its absence, a diagonal bar separates counts from the left and right body side. D = divided, Pd = partially divided, Reg = regenerated, Ud = undivided. For other abbreviations see materials and methods.

Character	MUSM 31978	NMP-P6V 75867	MUSM 31991	MUSM 31185	MUSM 31160	NMP-P6V 75084	NMP-P6V 75092	NMP-P6V 75090	NMP-P6V 75091
Sex	M	M	M	M	M	M	M	M	M
SVL	60.9	59.6	58.7	54.2	53.6	57.0	57.5	51.1	57.7
TL (Reg)	89.7	(51.0)	(68.3)	80.8	(43.5)	(72.7)	(80.6)	(48.0)	(45.4)
HL	17.3	16.0	15.8	15.0	14.2	14.3	15.3	13.1	16.0
HW	11.5	11.7	9.8	9.2	9.1	9.9	10.8	9.1	10.9
HD	9.9	8.7	8.9	7.1	7.4	7.6	8.6	6.8	8.7
E-N	4.6	4.7	4.3	3.6	4.1	4.3	4.3	4.2	4.3
FLL	14.3	15.8	13.0	13.1	12.4	13.4	14.9	12.8	14.0
HLL	21.1	22.4	19.0	17.1	17.2	20.0	20.1	18.7	20.4
AGD	35.0/ 34.4	30.5/ 30.6	31.1/ 31.3	28.3/ 28.4	27.4/ 27.3	30.0/ 29.0	30.8/ 30.7	25.0/ 25.0	30.4/ 30.4
Supralabials	6/6	7/7	7/7	6/5	6/6	5/5	6/6	7/7	6/6
Prefrontals	+	–	+	–	–	–	+	–	+
Loreal scale	–	+	–	–	+	–	–	+	+
Nasal scales	Ud/Pd	Ud	Pd	Ud	Pd	Pd	D	Pd	D/Pd
Gular scales	11	12	10	12	11	11	12	12	11
Collar scales	9	9	8	8	10	9	8	9	8
Dorsal scales	33	33	32	32	37	34	32	32	32
Lateral scales	5/3	7/6	3/3	2/2	3/6	2/3	3/2	4/4	3/3
Scales around midbody	33	38	33	35	34	34	33	39	32
Ventral scales	21	19	20	20	22	20	18	17	18
Ventrals across belly	10	9	10	10	10	10	10	10	10
Preanal plates	2+4	2+4	2+4	2+4	2+4	2+4	2+2	2+4	2+3
Lamellae under Finger IV	13/12	14/14	10/10	10/10	12/12	10/10	12/12	12/12	13/12
Lamellae under Toe IV	15/17	19/20	14/16	15/16	18/18	18/17	17/17	17/17	17/18
Femoral pores	6/5	9/10	5/5	7/6	9/10	7/6	7/7	6/7	6/7

Table 2. Measurements (in mm) and pholidotic characters of adult females of *Wilsonosaura josyi* gen. n. et comb. n. A plus sign indicates the presence of a character, a dash indicates its absence, a diagonal bar separates counts from the left and right body side. D = divided, Pd = partially divided, Reg = regenerated, Ud = undivided. For other abbreviations see materials and methods.

Character	MUSM 31188	NMP-P6V75868	MUSM 31973	NMP-P6V75869
Sex	F	F	F	F
SVL	56.1	51.4	48.7	46.8
TL (Reg)	(50.0)	(66.8)	67.2	(66.5)
HL	13.9	12.3	11.1	12.3
HW	8.7	8.0	7.0	7.3
HD	7.0	6.7	5.7	5.8
E-N	3.9	3.7	3.4	3.9
FLL	13.8	12.4	10.6	12.2
HLL	19.2	17.9	16.5	17.6
AGD	31.6/32.0	28.3/28.1	25.9/26.5	23.0/24.1
Supralabials	7/7	7/7	6/5	7/6
Prefrontals	+	+	+	+
Loreal scale	–	+	–	+
Nasal scale	Pd	D	Pd/Ud	D

Character	MUSM 31188	NMP-P6V75868	MUSM 31973	NMP-P6V75869
Gular scales	11	10	10	11
Collar scales	9	9	8	9
Dorsal scales	33	34	33	31
Lateral scales	3/3	3/3	2/2	5/5
Scales around midbody	42	35	36	38
Ventral scales	20	19	20	17
Ventrals across belly	10	10	10	10
Preanal plates	2+4	2+5	2+4	3+6
Lamellae under Finger IV	12/14	13/13	11/11	11/11
Lamellae under Toe IV	17/17	19/18	17/17	17/17
Femoral pores	7/8	2/2	4/4	2/2

Table 3. Measurements (in mm), ratios with average and standard deviation in parenthesis, and pholidotic characters of newly collected adult *Wilsonosaura josyi* gen. n. et comb. n. and types of *Euspondylus josyi*. A plus sign indicates the presence of a character, a dash indicates its absence, a diagonal bar separates counts from the left and right body side. For other abbreviations see materials and methods. Data for *E. josyi* taken from Köhler (2003), centralized date are indicate not separated by sex.

Character	*W. josyi*	*W. josyi*	*E. josyi*	*E. josyi*
Sex (sample size)	M (N = 9)	F (N = 4)	M (N = 20)	F (N = 20)
Max SVL	60.9	56.1	62.0	55.0
HL/HW	1.37–1.63 (1.49±0.09)	1.54–1.68 (1.60±0.06)	1.23–1.49 (1.37±0.07)	1.30–1.53 (1.42±0.06)
Dorsal scales	Weakly keeled to smooth		keeled	
Loreal (present/absent)	(42%/59%)		(100%/0)	
Prefrontals	+ or –		+	
Postparietals	5		3–4	
Dorsal scales	32–37 (33.0±1.7)	31–34 (32.8±1.3)	29–35 (32.2±1.40)	
Lateral scales	2–7	2–5	2–3	
Scales around midbody	32–39 (34.6±2.4)	36–42 (37.8±3.1)	31–37 (33.3±1.22)	
Ventral scales	17–22 (19.4±1.6)	17–20 (19.0±1.4)	16–19 (17.7±0.88)	
Ventrals across belly	9–10	10	10	
Lamellae under Finger IV	10–14	11–14	11–13	
Lamellae under Toe IV	14–20	17–19	15–19	
Femoral pores (total number)	11–19	4–15	12–16	2–8
Femoral pores per limb	5–10 (6.9±1.6)	2–8 (3.9±2.4)	6–8 (6.7±0.50)	1–4 (2.4±0.66)

Morphology of the tongue (Fig. 8): The tongues of five specimens (MUSM 31160, 31185, 31973, NMP-P6V 75090, 75091) were examined. The dorsal surface of the tongue (Fig. 8A) is covered with scale-like papillae except for the level anterior to the bifurcation and the distal bifurcated part. The ventral surface of the tongue (Figs 8B, C) has 6–8 distinct infralingual plicae which are slightly swollen, narrow, and decrease in size and width from anterior to posterior. The first infralingual plica is distinctly larger, all are steeply slanted and meet at an acute angle on the midline. The free edges of the infralingual plicae are blunt.

Distribution, natural history, and threat status: *Wilsonosaura josyi* comb. n. is known from nine localities in upper montane forests and puna habitats of the eastern Andes in central Peru (regions Junín and Pasco) from 2400 to 3726 m a.s.l. (Figs 1, 9). The type locality lies in the area of the town of Maraynioc. Four localities are inside the Pui Pui Protected Forest, two in its close surroundings, one inside the Bosque de Sho'llet (Fig. 9C), and one close to the road to the town of Satipo. The species probably occurs also at two collecting sites in the Region Huancavelica (Torres-Carvajal et al. 2016): Mantaro Valley (CORBIDI 8815), Tayacaja: Colcabamba-Quintao District (CORBIDI 13634, 13636). Nevertheless, we did not examine specimens from these two localities and therefore consider this determination as preliminary. Our specimens were found on the ground under rocks or active on moss in a swamp (MUSM 31127). The puna localities (Fig. 9A) are covered by grassland formation dominated by *Jarava ichu*. Along banks of small streams and around solitary rocks or stone groups thick moss layers are present. Localities lying in the transition zone between puna and upper montane forest are overgrown by low trees and bushes covered with diverse lichens, bromeliads, orchids, and other epiphytes. Fields of deep layers of different mosses intermixed with ferns frequently occur in this zone (Figs 9B, D). One adult female (MUSM 31188) collected on 23 June 2013 at 3350 m a.s.l. contained two hard-shelled eggs which measured 12.5 × 7.6 and 12.1 × 7.8 mm. No syntopic gymnophthalmid species have been recorded with *Wilsonosaura josyi* gen n. et comb. n. Potential sympatric species may include the arboreal *Dendrosauridion yanesha* from the surroundings of the Yanachaga-Chemillén National Park recorded at 2780 m a.s.l. (Lehr et al. 2019), the arboreal *Euspondylus excelsum* from the montane forests of the PPPF recorded at 1550 m a.s.l. (Lehr et al. 2018), the arboreal *Selvasaura brava* recorded from the PPPF between 1678 and 1700 m a.s.l. (Moravec et al. 2018), one species of terrestrial gymnophthalmid, *Proctoporus chasqui* from the upper montane forest of the PPPF at 3038 m a.s.l., and an undescribed terrestrial *Proctoporus* species (*Proctoporus* sp. 4 sensu Moravec et al. 2018, Supplementary material I) from 1700 m a.s.l. of the PPPF. We suggest classifying *Wilsonosaura josyi* as "Least Concern" according to the IUCN red list criteria (IUCN 2012) and its large distributional area.

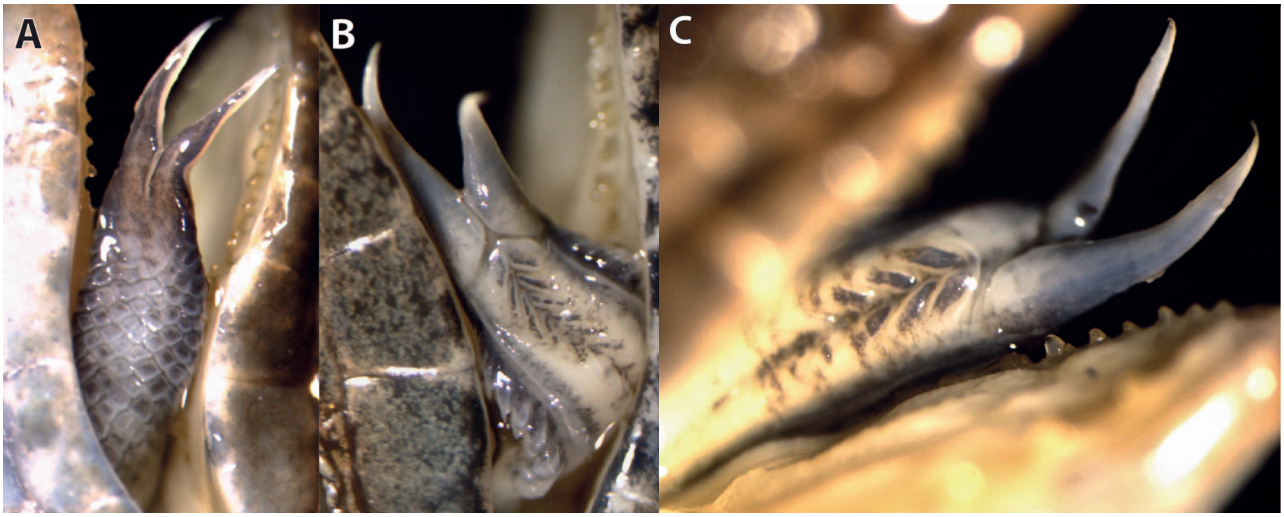

Figure 8. Tongue morphology of *Wilsonosaura josyi* gen. n. et comb. n. in dorsal (A, NMP-P6V 75091), and ventral (B, NMP-P6V 75090; C, NMP-P6V 75091) views. Photos by J. Moravec.

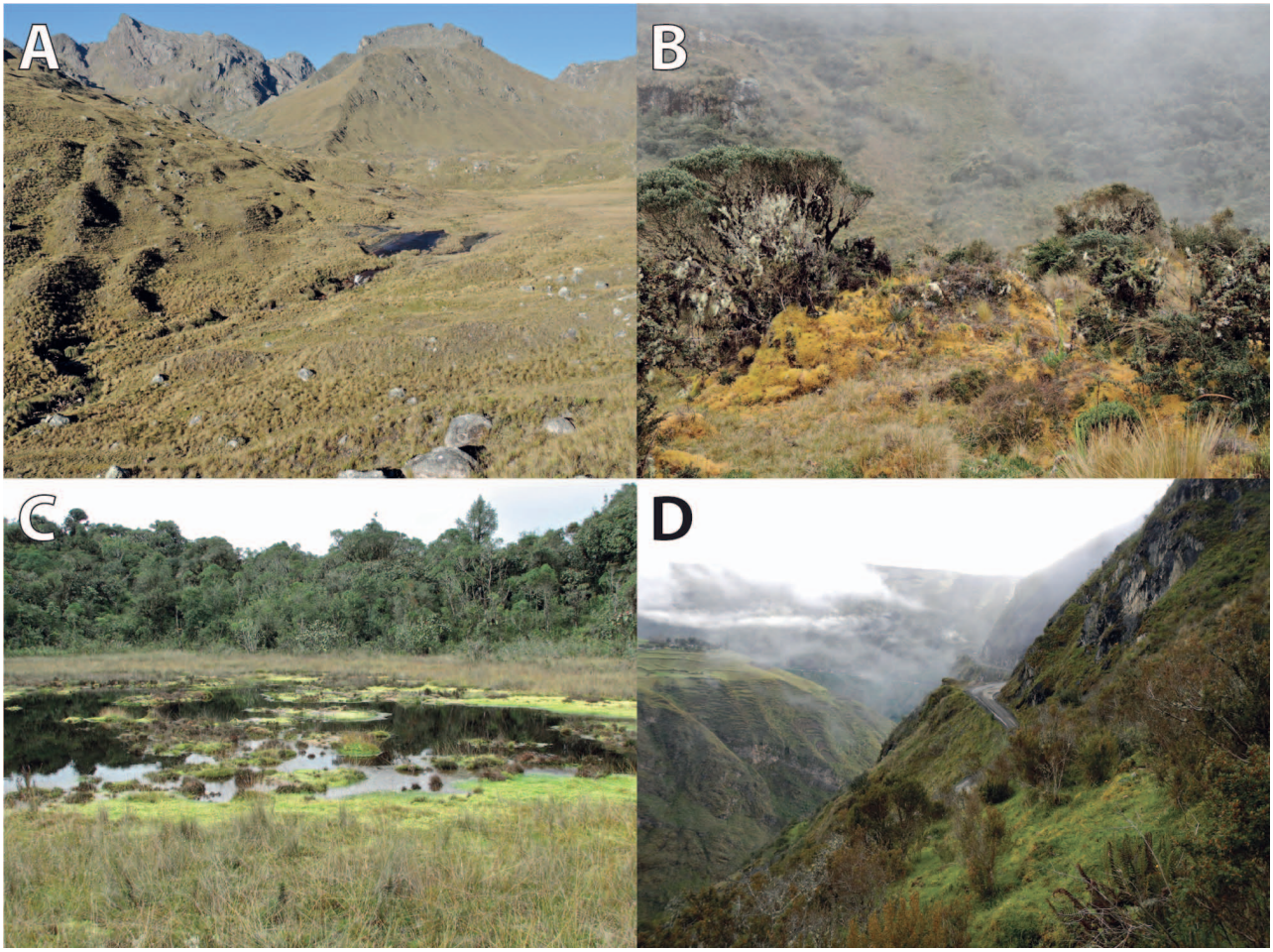

Figure 9. Selected collecting sites and habitats of *Wilsonosaura josyi* gen. n. et comb. n. (A) Hatunpata, 3710 m a.s.l., 28 June 2013, (B) Trancapampa, 3550 m a.s.l., 2 July 2013, (C) Bosque de Sho'lett, 2430 m a.s.l., 27 January 2012, and (D) right slope near road leading to Satipo (before Maraynioc), 3726 m a.s.l., 24 April 2012. Photos by J. Moravec (A, B, C), and E. Lehr (D).

Discussion

This study advances our knowledge of the herpetofauna living at high elevations in central Peru. Our field surveys of the Pui Pui Protected Forest (PPPF) and surrounding areas have revealed that most species inhabiting high Andean habitats are endemic. In total, we have detected seven species in the Andean grassland of the PPPF. Five of these species and one genus (= 86%) were new to science: *Phrynopus inti* Lehr, von May, Moravec & Cusi, 2017; *Pristimantis attenboroughi* Lehr & von May, 2017; *P. bounides* Lehr, von May, Moravec & Cusi, 2017; *P. humboldti* Lehr, von May, Moravec & Cusi, 2017; *P. puipui* Lehr, von May, Moravec & Cusi, 2017; and *Wilsonosaura josyi*, this paper. The only taxon not new to science was *Gastrotheca griswoldi* Shreve, 1941.

Molecular techniques have helped to reveal cryptic diversity (e.g., von May et al. 2018: two species under the name *Phrynopus juninensis*) or correct generic or familiar affiliations (Lehr et al. 2005), the recognition of synonyms (Catenazzi & Lehr 2018) or new genera (Moravec et al. 2018). We follow the definition for cryptic species as defined by Bickford et al. (2007) who "consider two or more species to be 'cryptic' if they are, or have been, classified as a single nominal species because they are at least superficially morphologically indistinguishable." We define a genus as cryptic if the inferred relationships based on molecular data supported a unique history of divergence of the new genus from other closely related genera. Our analyses distinguished *Wilsonosaura* gen. n. et comb. n. from other genera, yet obvious diagnostic morphological synapomorphies have not been recognized. The term cryptic genus has been used mostly by botanists (e.g., Gagnon et al. 2015). It would be naïve to think that a genus simply does not exist when its morphological recognition as such is difficult if not impossible in the context of morphological homoplasy and convergence. Moreover, morphological data can be misleading in the recognition of some genera. For instance, based on molecular data, Lehr & von May (2017) and Lehr et al. (2017a) described two new species of *Pristimantis* (*P. attenboroughi, P. puipui*) that both lack circumferential groves on fingers and toes and are externally indistinguishable from the Andean frog genus *Phrynopus*. It was previously thought that the lack of circumferential groves was among the characters defining *Phrynopus*, whereas *Pristimantis* were known to have well defined circumferential groves (e.g., Lynch 1975, Duellman & Lehr 2009). A historic revision of the currently recognized gymnophthalmid genera of the subfamily Cercosaurinae shows how weakly significant some of the traditionally used morphological characters have been (e.g. O'Shaughnessy 1881, Boulenger 1885, Burt & Burt 1931, Ruibal 1952, Uzzell 1973, Oftedal 1974, Avila-Pires 1995, Doan 2003, Köhler & Lehr 2004, Doan & Castoe 2005, Goicoechea et al. 2012, Torres-Carvajal et al. 2016). Placing several nominal genera of gymnophthalmids into synonymy with others, e.g. *Pantodactylus* and *Prionodactylus* with *Cercosaura* or *Opipeuter* with *Proctoporus*, had led to a morphological redefinition of the revised genera (see Doan 2003, Goicoechea et al. 2012). As a result, morphological variation within some of the redefined genera (e.g. *Cercosaura*, *Proctoporus*) is relatively high. Since our specimens of *Wilsonosaura josyi* gen. n. et comb. n. display unusually high intraspecific morphological variation (e.g. absence or presence of prefrontal and loreal shields, dorsal scales weakly keeled to smooth, line of one to four lateral scales at the middle of flanks occasionally widened vertically by additional lateral scales) traditionally used external morphological characters fail in the morphological separation of *Wilsonosaura* gen. n. from the highly variable *Proctoporus*. While it would be premature to say that *Wilsonosaura* gen. n. is not diagnosable, distinguishing it at least superficially from *Proctoporus* will remain a challenge until the cryptic features of the new genus are uncovered. Thus, we believe that future osteological and anatomical studies will help to find missing differential characters.

While species are true taxonomic units, genera are artificial constructs that combine species with a shared ancestor and phylogenetic history. Therefore, we consider the definition of the new genus *Wilsonosaura* gen. n. justified as it reflects the evolutionary history and diversity within Gymnophthalmidae.

The morphology of the ventral surface of the tongue of *Wilsonosaura josyi* gen. et comb. n. matches the condition described by Harris (1985: fig 2a, pp 562) for 14 different genera including *Proctoporus*. As already noted by Harris (1985) the tongue morphology has not received much attention. The tongue is indeed difficult to examine when specimens were not preserved with an open mouth. Generic synapomorphies have not been recognized for the tongue in gymnophthalmids.

Given that convergence of morphological adaptations to fossoriality has occurred multiple times (Pellegrino et al. 2001), we propose the use of molecular data, in addition to morphological data, for any description of a new taxon within Gymnophthalmidae. We also recognize that morphological characters for Gymnophthalmidae need to be better defined, observed, and described. For example, while we compared *Wilsonosaura* gen. n. with other gymnophthalmid genera, we identified an easy recognizable morphological character for *Cercosaura* that serves as a synapomorphy (median gulars distinctly enlarged forming longitudinal rows) for this genus which has not been used before. Future studies focusing on osteological and myological characters may reveal diagnosable synapomorphies for Gymnophthalmidae (e.g., Montero et al. 2002).

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Appendix

Comparative material examined: *Anadia bogotensis:* Colombia: FMNH 177263–64, 177663. *Anadia rhombifera:* Colombia: FMNH 167601. *Cercosaura eigenmanni:* Bolivia, Bioceanica: NMP-P6V 72609. *Cercosaura oshaughnessyi:* Peru: Almendras (Arboretum and surroundings), 17–18 km SW of Iquitos: NMP-P6V 7160/1–2. *Dendrosauridion yanesha:* Peru: Region Pasco: from the mountain ridge close to the radio antenna at Chacos, 2780 m a.s.l.: MUSM 25345 (holotype), NMP-P6V 75204 (paratype). *Euspondylus excelsum:* Peru: Region Junín: coffee plantation on the trail leading to the Pui Pui Protected Forest, 1550 m: MUSM 31949. *Euspondylus josyi* (all paratypes): Peru: Region Junín: Marayniioc, 2880 m a.s.l.: MCZ 85732, 85762, 85779–80, 85782, 85797. *Euspondylus nellycarrillae:* Peru: Region Huánuco: Chaglla, 2980 m a.s.l.: MUSM 20090–91, 20102–03 (all paratypes). *Petracola labioocularis:* Peru: Region Huánuco: Chaglla, 2980 m a.s.l.: MUSM 20092 (holotype), MUSM 20093–95 (paratypes). *Petracola ven-*

trimaculata: Peru: Region Cajamarca: Celendin: MUSM 27295, 27297–27303. *Proctoporus chasqui:* Peru: Region Junín: near road leading to Comas, 3038 m: MUSM 31159, 31162, IWU 120; Region Junín: Pui Pui Protected Forest, Hito 3, 1615 m: MUSM 31172, IWU 140. *Proctoporus guentheri:* Peru: Cuzco: UMMZ 131674 (two specimens), Bolivia: Cochabamba: 132145, 132146. *Proctoporus laudahnae:* Peru: Region Huánuco: Palma Pampa, 3010 m a.s.l.: MUSM 20116 (holotype). *Proctoporus spinalis:* Peru: Region Pasco: Oxapampa: MUSM 17725–28. *Proctoporus sucullucu:* Peru: Region Apurimac: Chinchay: MUSM 27987–89, 2796–98. *Proctoporus* sp.: Peru: Cuzco: UMMZ 131673 (5 specimens). *Selvasaura brava:* Peru: Region Junín: from the border of the Pui Pui Protected Forest, 1700 m: MUSM 32738 (holotype), 32739 (paratype), NMP-P6V 75653–54 (paratypes). *Wilsonosaura josyi* gen. n. et comb. n*:* Peru: Región Junín: from the Pui Pui Protected Forest at Hatunpata (11°18'07.9"S, 75°01'35.0"W; WGS84), 3710 m a.s.l., collected on 28 June 2013 by E. Lehr, J. Moravec, and J. C. Cusi: MUSM 31978 (male); from the Pui Pui Protected Forest at Quebrada Tarhuish, left bank of Antuyo River, "Tinqu" (11°22'39.5"S, 74°56'13.5"W), 3555 m a.s.l., NMP-P6V 75867 (male), MUSM 31188 (female), collected on 12 May 2012 by E. Lehr and R. von May; from the Pui Pui Protected Forest at Forest at Trancapampa (11°17'49.2"S, 75°00'46.3"W) 3550 m a.s.l., MUSM 31991 (male), collected on 2 July 2013 by E. Lehr, J. Moravec, and J. C. Cusi; from the Pui Pui Protected Forest at Antuyo Bajo (11°18'53.4"S, 74°59'34.8"W), 3400 m a.s.l., MUSM 31994 (juvenile), NMP-P6V 75085 (juvenile), collected on 2 July 2013 by E. Lehr, J. Moravec, and J. C. Cusi; from Tasta, in a forest patch near Evaristo's house (11°26'48.8"S, 74°54'2.8"W), 3609 m a.s.l., MUSM 31185 (male), collected on 9 May 2012 by E. Lehr and R. von May; from Toldopampa, km 134 (11°29'03.5"S, 74°53'27.3"W), 3350 m a.s.l., NMP-P6V 75084 (male), MUSM 31188 (female), collected on 23 June 2013 by E. Lehr, J. Moravec, and J. C. Cusi; from the right slope near road leading to Satipo (11°39'54.3"S, 75°02'12.6"W), 3726 m a.s.l., MUSM 31160 (male), NMP-P6V 75089 (juvenile), collected on 24 April 2012 by E. Lehr and R. von May; from Maraynioc, 200 m downhill (11°20'44.2"S, 75°26'41.3"W), 3504 m a.s.l., NMP-P6V 75090–92 (males), NMP-P6V 75868, 75869 (females), collected on 27 April 2012 by R. von May; Region Pasco: from Bosque de Sho'llet (10°40'531S, 75°19'2897W), 2430 m a.s.l., MUSM 31127 (juvenile), collected on 27 January 2012 by E. Lehr, J. Moravec, and J. C. Cusi.