

Letter to the editor

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A new species of *Occidozyga* Kuhl and van Hasselt, 1822 (Anura: Dicroglossidae) from Southern Guangxi, China

A new species of the genus *Occidozyga* is reported from Southern Guangxi, China, based on morphological characters and molecular analyses. Morphological data revealed that the new species, *Occidozyga shiwandashanensis* sp. nov., differs from its congeners by a combination of the following characters: (1) medium body size (SVL 25.2–33.8 mm in males, 34.9–38.9 mm in females); (2) pale brown dorsum with irregular pale dark spots, especially on head; (3) creamy white ventral surface with brown spots on lateral margin and throat; (4) tongue fleshy, rounded, without notch, (5) tympanum hidden; (6) finger webbing absent and toe webbing full, but fourth toe not webbed to discs; (7) tips of fingers pointed, tips of toes rounded, slightly expanded into disc. The new species occurs on Mt. Shiwandashan and inhabits montane evergreen forests at 500–600 m a.s.l.

The genus *Occidozyga* was erected by Kuhl & van Hasselt (1822) for its type species *Occidozyga lima* Gravenhorst, 1829. However, its members and validity remain controversial. Some authors have treated *Phrynoglossus* as a synonym of *Occidozyga* (Chan et al., 2021; Flury et al., 2021; Frost, 2021), whereas others have treated them as two valid genera (Köhler et al., 2021; Trageser et al., 2021). Based on mtDNA data, morphological characters, and behavioral biology, Köhler et al. (2021) argued that *Phrynoglossus* is a valid genus distinct from *Occidozyga*. However, based on mtDNA and nuclear genes, Flury et al. (2021) obtained robust phylogenetic trees supporting *Phrynoglossus* as a synonym of *Occidozyga*.

At present, two *Occidozyga* species have been recorded in China, i.e., *Occidozyga lima* and *Occidozyga martensii* Peters, 1867, which occur in southern and southwestern China (Che & Wang, 2016). In 2021, we collected 32 specimens of *Occidozyga* from Mt. Shiwandashan, Fangcheng, Guangxi, China. All animal care and experimental procedures were

approved by the Ethical Committee of Animal Experimentation of Nanning Normal University (approval No. NNU2018AC–02). All specimens were measured after fixation in 10% formalin for 48 h and then stored in 75% ethanol and deposited at Nanning Normal University (NNU) and Natural History Museum of Guangxi (NHMG). Muscle samples were stored in 100% ethanol for molecular analysis. Measurements referred to Matsui et al. (2021) and Köhler et al. (2021) and were taken with a digital caliper to the nearest 0.1 mm. Measurements included: snout-vent length (SVL); head length from tip of snout to rear of jaws (HL); head width at commissure of jaws (HW); distance from eye front to nostril (EN); snout length from tip of snout to anterior eye corner (SNT); diameter of exposed portion of eyeball (ED); nostril-eyelid length (N-EL); internarial space distance (IN); interorbital distance (IOD); upper eyelid width (UEW); forelimb length from elbow to tip of finger III (FLL); hand length (HAL); tibia length with flexed hindlimb (TIB); foot length from tibiofibular end to tip of fourth toe (FL); thigh length from vent to knee (THL); first toe length (1TOEL); and inner metatarsal tubercle length (IMTL). Sex was determined by direct observation of gonads.

Genomic DNA was isolated from muscle tissue using Tiangen Biotech Co., Ltd. tissue extraction kits (China). Mitochondrial 12S and 16S rRNA gene fragments (~2 400 bp) were amplified using the primer pairs reported in Matsui et al. (2010). Polymerase chain reaction (PCR) amplification was performed under the following protocols: initial denaturation step for 3 min at 94 °C, 35 cycles of denaturation for 40 s at 94 °C, annealing for 40 s at 50 °C, extension for 50 s at 72 °C, and final extension for 10 min at 72 °C. The PCR products were sequenced on an ABI Prism 3730 automated DNA sequencer (Applied Biosystems, USA). Newly obtained sequences were deposited in GenBank (MZ747455–MZ747458). Homologous DNA sequences of *Occidozyga* species were downloaded from GenBank,

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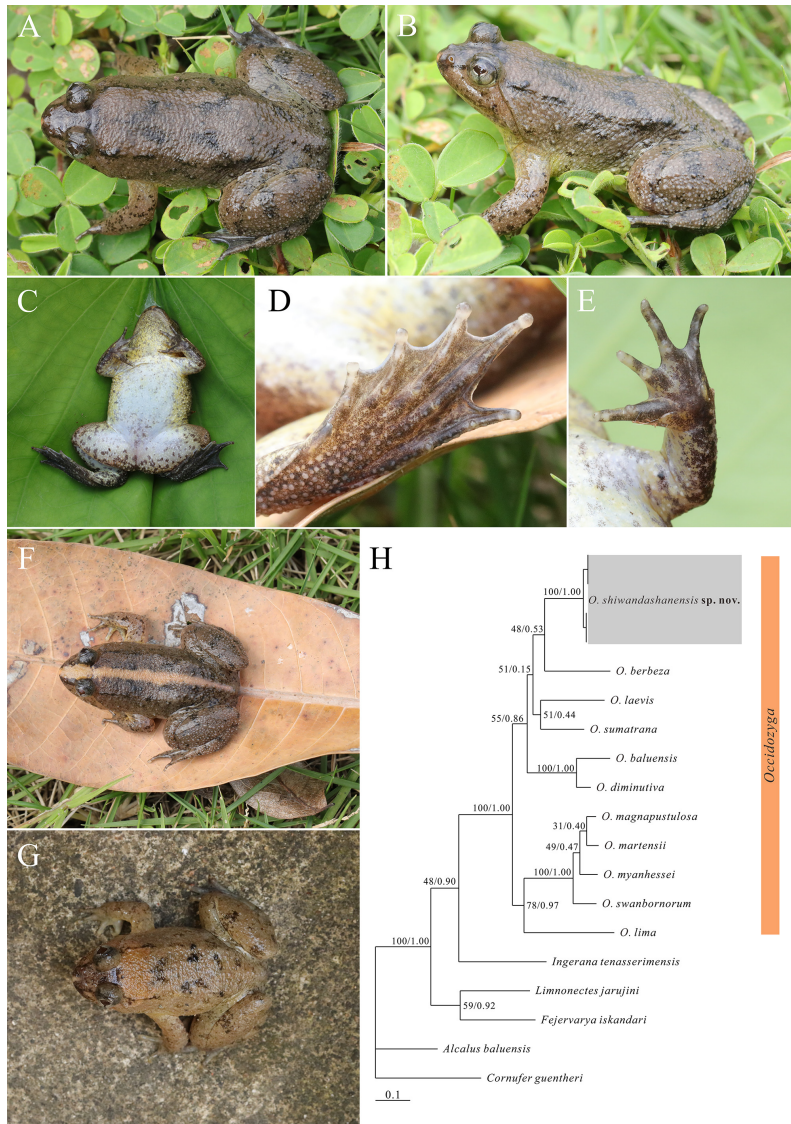


Figure 1 Morphological characters and molecular phylogenetic trees of *Occidozyga shiwandashanensis* sp. nov.

A: Dorsal view; B: Lateral view; C: Ventral view; D: Ventral view of foot; E: Ventral view of hand; F: Various individuals showing broad pale-yellow stripe from tip of snout to vent; G: Various individuals showing broad pale yellow transverse stripe on posterior of eyes; H: Maximum-likelihood (ML) and Bayesian inference (BI) trees based on mitochondrial 12S and 16S rRNA gene fragments. Node supports are indicated on branches as ML support and Bayesian posterior probabilities. Photos by Wei-Cai Chen.

including *O. baluensis*, *O. berbeza*, *O. diminutiva*, *O. laevis*, *O. lima*, *O. magnapustulosa*, *O. martensii*, *O. myanhesssei*, *O. sumatrana*, and *O. swanbornorum*. Outgroups followed Matsui et al. (2021) and Flury et al. (2021) (Supplementary Table S1). Phylogenetic relationships were calculated using maximum-likelihood (ML) and Bayesian inference (BI) methods. The ML analyses were conducted using the CIPRES Science Gateway (<https://www.phylo.org/portal2/home.action>) with default settings. BI was performed using MrBayes v3.2. The best-fit model (GTR+I+G) of evolution for the 12S+16S rRNA genes was selected in MrModeltest v2.3 based on Akaike Information Criterion. Uncorrected pairwise sequence divergence was analyzed in MEGA v7 using 16S fragments (~550 bp).

The ML and BI analyses generated essentially identical

topologies (Figure 1). Based on the phylogenetic trees, the monophyly of *Occidozyga* was supported with high node values, although the relationships among species were unresolved. Uncorrected *p*-distances between our specimens and all homologous sequences available in GenBank were greater than 13.0% (Supplementary Table S2). Our specimens differed from all known congeners in China and adjoining countries based on diagnostic morphological characters and molecular analyses. Thus, we described the specimens as a new species.

Taxonomic account

***Occidozyga shiwandashanensis* sp. nov.** (Figure 1A–G)

Holotype: NNU202103326, adult male (Figure 1A–E),

collected at Mt. Shiwandashan, Fangcheng, Guangxi, China (N21.854°, E108.881°, 550 m a.s.l.), collected by Wei-Cai Chen on 9 April 2021.

Paratypes: NNU202103284 and NNU202103297–9, adult males, NNU202103285, adult female, collected at type locality on 1 April 2021 by Wei-Cai Chen; NNU202103320, NNU202103324, NNU202103327, NNU202103329–34, adult males, NNU202103321–3, NNU202103325, NNU202103328, adult females, collected at type locality on 9 April 2021 by Wei-Cai Chen. NHMG202104061–2, NHMG202104066, NHMG202104069–71, NHMG202104074–5, adult males, NHMG202104063–5, NHMG202104068, adult females, collected at Mt. Shiwandashan (N21.823°, E107.761°, 650 m a.s.l.) on 21 April 2021 by Yun-Ming Mo, Xiao-Wen Liao, and Zhong Huang.

Etymology: The specific epithet “*shiwandashanensis*” refers to the type locality, Mt. Shiwandashan. The suggested English name is Shiwandashan Puddle Frog, and the Chinese name is Shi Wan Da Shan Fu Wa (十万大山浮蛙).

Diagnosis: *Occidozyga shiwandashanensis* sp. nov. can be distinguished from its congeners by a combination of the following characters: (1) medium body size (SVL 25.2–33.8 mm in males, 34.9–38.9 mm in females); (2) pale brown dorsum with irregular pale dark spots, especially on dorsal surface of head; (3) creamy white ventral surface with brown spots on lateral margin and throat; (4) tongue fleshy, rounded, without notch, (5) tympanum hidden; (6) finger webbing absent and toe webbing full, but fourth toe not webbed to disc; (7) tips of fingers pointed, tips of toes rounded, slightly expanded into disc; (8) tarsal fold present; (9) eyes laterally oriented.

Description of holotype: Adult male, body stocky; head shorter than wide (HW/HL=1.32); snout rounded in dorsal and lateral views, projecting slightly over lower jaw; nostril oval-shaped and dorsolateral, closer to tip of snout than eye; canthus rostralis broadly rounded; loreal region vertical and slightly concave; interorbital space flat; pupil diamond-shaped; eye diameter less than snout length (ED/SNT=0.93); tympanum hidden; distinct raised supratympanic fold from corner of eye to shoulder; vomerine teeth absent; tongue fleshy, rounded, without notch. Tips of fingers pointed; relative finger lengths II<IV<III; nuptial pad present; subarticular tubercles rounded, raised; inner and outer palmar tubercles present; finger webbing absent. Tips of toes rounded, slightly expanded into disc; relative toe lengths I<II<V<III<IV; toes with dermal fringes; subarticular tubercles present; prominent, elongated inner metatarsal tubercle; outer metatarsal tubercle absent; toe webbing full, but fourth toe not webbed to disc, instead showing deep incision between fourth and fifth toes; tarsal ridge present. Tibia length 46% of SVL; tibia-tarsal articulation just reaching posterior edge of eye; heels not touching when thighs appressed at right angles to body. Dorsal surface shagreened with small, raised tubercles, more prominent on flanks; ventral surface of throat, chest, abdomen, and thighs scattered with small glands; dorsolateral fold absent (Figure 1A–E).

Color: In life, dorsum pale brown with irregular pale dark spots; ventral surface creamy white with brown spots on lateral margin and throat; ventral surface of limbs creamy

white with dense brown spots; ventral surfaces of palm and feet brown; pupil reddish-brown; iris pale brown. In preservative, color generally faded, but pattern unchanged.

Variation: Measurements of the type series are shown in Supplementary Table S3. Irregular pale dark spots on dorsum varied. Some individuals showed broad pale-yellow stripe from tip of snout to vent (Figure 1F), others showed broad pale yellow transverse line on posterior of eyes (Figure 1G).

Measurements of holotype (in mm): SVL 33.8, HL 9.5, HW 12.5, SNL 1.5, SNT 4.4, ED 3.7, N-EL 1.5, IN 2.5, IOD 1.9, UEW 2.4, FLL 13.3, HAL 7.8, TIB 14.7, FL 14.2, THL 15.5, 1TOEL 6.1, IMTL2.2.

Ecology and distribution: The new species occurs in an evergreen forest at Mt. Shiwandashan between 500–650 m a.s.l. Specimens were found in muddy patches. Advertisement calls were heard during fieldwork, but no amplexant pairs were discovered. Eggs were found near muddy areas attached to plant roots close to but not in water. To date, this species is only known from Mt. Shiwandashan.

Comparisons: Diagnostic morphological characters of the genus *Occidozyga* are shown in Supplementary Table S4. *Occidozyga shiwandashanensis* sp. nov. differs from other *Occidozyga* species based on both morphological and genetic data. Genetically, *Occidozyga shiwandashanensis* sp. nov. displayed distinct genetic distances (>13.0%) from all other *Occidozyga* species (Supplementary Table S2). Morphologically, *Occidozyga shiwandashanensis* sp. nov. differed from all known congeners based on a combination of the following morphological characters: medium body size (SVL 25.2–33.8 mm in males, 34.9–38.9 mm in females); dorsum pale brown with irregular pale dark spots; ventral surface creamy white with brown spots on lateral margin and throat; tongue fleshy, rounded, without notch; tympanum hidden; finger webbing absent, toe webbing full, except fourth toe not webbed to disc; finger tips pointed, toe tips rounded, slightly expanded into disc; and eyes laterally oriented.

Occidozyga shiwandashanensis sp. nov. differs from *O. baluensis* by: relatively larger SVL (25.2–33.8 mm in males, 34.9–38.9 mm in females); ventral surface creamy white with brown spots on lateral margin and throat; outer metatarsal tubercle and dorsolateral fold absent (vs. SVL 16.0–26.0 mm in males, 33.0–34.0 mm in females; abdomen spotted black and brown; outer metatarsal tubercle and dorsolateral skin fold present). *Occidozyga shiwandashanensis* sp. nov. differs from *O. berbeza* by: larger SVL (25.2–33.8 mm in males, 34.9–38.9 mm in females); ventral surface creamy white with brown spots on lateral margin and throat; dorsum pale brown with irregular pale dark spots, especially on dorsal surface of head (vs. SVL 16.0–18.0 mm in males, 18.0–19.0 mm in females; ventral body surfaces cream with large scattered dark gray spots on throat and posterior thigh; dorsal stripe broad, dark-brown, running from tip of snout posteriorly, diverging at sacrum, and continuing across groin to femur and tibia). *Occidozyga shiwandashanensis* sp. nov. differs from *O. celebensis* by: toes with terminal discs; nostril closer to tip of snout than eye, IND/IOD=1.3; dorsum pale brown with irregular pale dark spots, especially on dorsal surface of head; eyes laterally oriented; ventral surface creamy white with brown spots on lateral margin and throat (vs. toes with conical

tips; nostril midway between eye and snout tip, IND/IOD=2.0; eyes dorsolaterally oriented; dorsum olive with indistinct darker markings; ventral surface yellowish). *Occidozyga shiwandashanensis* **sp. nov.** differs from *O. diminutiva* by: relatively smaller SVL (25.2–33.8 mm in males, 34.9–38.9 mm in females); finger tips pointed; toe tips rounded, slightly expanded into disc (vs. SVL 35.0–37.0 mm in males, 40.0–51.0 mm in females; finger and toe tips with large discs). *Occidozyga shiwandashanensis* **sp. nov.** differs from *O. floresiana* by: relatively smaller SVL (25.2–33.8 mm in males, 34.9–38.9 mm in females); finger tips pointed; tongue fleshy, rounded, without notch (vs. SVL 35.0–37.0 mm in males, 40.0–51.0 mm in females; fingers with terminal discs; tongue with notch). *Occidozyga shiwandashanensis* **sp. nov.** differs from *O. laevis* by: relatively smaller SVL (25.2–33.8 mm in males, 34.9–38.9 mm in females); toe webbing full, but fourth toe not webbed to disc; eyes laterally oriented (vs. SVL 26.0–42.0 mm in males, 35.0–62.0 mm in females; fourth toe broadly webbed to disc; eyes dorsolaterally oriented). *Occidozyga shiwandashanensis* **sp. nov.** differs from *O. lima* by: larger SVL (25.2–33.8 mm in males, 34.9–38.9 mm in females); tongue fleshy, rounded, without notch; dorsal surface shagreened with small, raised tubercles, more evident on flanks; toe tips rounded, slightly expanded into disc; bold black horizontal stripe on rear of thighs and strongly patterned venter with pair of dark chin stripes absent (vs. SVL 22.0–26.0 mm in males, 26.0–32.0 mm in females; tongue slender, worm-like; dorsum strongly tuberculate; toe tips pointed; bold black horizontal stripe on rear of thighs; strongly patterned venter with pair of dark chin stripes). *Occidozyga shiwandashanensis* **sp. nov.** differs from *O. magnapustulosa* by: larger SVL (25.2–33.8 mm in males); finger tips pointed; toe tips rounded, slightly expanded into disc; finger webbing absent; toe webbing full, but fourth toe not webbed to disc, instead showing deep incision; dorsal surface shagreened with small, raised tubercles, more evident on flanks; ventral surface creamy white with brown spots on lateral margin and throat (vs. SVL 16.0–21.0 mm in males; remnant webs between two inner fingers; toe tips blunt, lacking discs, web extending to toe tips, without deep incision; dorsum covered with craterlike warts, some with white tips; male throat heavily pigmented). *Occidozyga shiwandashanensis* **sp. nov.** differs from *O. martensii* by: larger SVL (25.2–33.8 mm in males, 34.9–38.9 mm in females); finger tips pointed; dorsal surface shagreened with small, raised tubercles, more evident on flanks; ventral surface creamy white with brown spots on lateral margin and throat (vs. SVL 19.0–24.0 mm in males, 26.0–28.0 mm in females; finger tips with flattened discs; dorsum lightly rugose; chin and throat dark in males, or dusky to immaculate in females). *Occidozyga shiwandashanensis* **sp. nov.** differs from *O. myanhessi* by: relatively larger SVL (25.2–33.8 mm in males, 34.9–38.9 mm in females); tympanum hidden; dorsal surface shagreened with small, raised tubercles, more prominent on flanks; inner metatarsal tubercle pronounced and elongated; outer metatarsal tubercle absent (vs. SVL 16.0–26.0 mm in males, 33.0–34.0 mm in females; tympanum concealed, slightly depressed relative to skin of temporal region, tympanic rim weakly elevated relative to tympanum; skin smooth on top of head, dorsum, and flank;

outer metatarsal tubercle not differentiated, but rather two tiny tubercles present in area; inner metatarsal tubercle flap-like; abdomen spotted black and brown; outer metatarsal tubercle and dorsolateral skin fold present). *Occidozyga shiwandashanensis* **sp. nov.** differs from *O. semipalmata* by: finger tips pointed; dorsum pale brown with irregular pale dark spots, especially on dorsal surface of head (vs. fingers with flattened terminal discs, slightly wider than diameter of penultimate phalange; dorsum with some dark mottling). *Occidozyga shiwandashanensis* **sp. nov.** differs from *O. sumatrana* by: dorsum pale brown with irregular pale dark spots, especially on dorsal surface of head; toe webbing full, but fourth toe not webbed to disc; eyes laterally oriented (vs. dorsum gray brown or olive brown, usually mottled dark brown; dark brown band on each side of cloaca; hind feet fully webbed; eyes dorsolaterally oriented). *Occidozyga shiwandashanensis* **sp. nov.** differs from *O. swanbornorum* by: ventral surface creamy white with brown spots on lateral margin and throat; tarsal tubercles and fold present; tympanum hidden; dorsolateral ridges on shank absent; relative finger lengths II<I<IV<III; relative toe lengths I<II<V<III<IV (vs. venter uniform cream white, becoming brown with white mottling and groups of minute dark gray flecks present in gular region; tarsal tubercles and fold absent; tympanum small, rounded; fine dorsolateral ridges on shank; relative finger lengths IV<II<I<III; relative toe lengths I<V<II<III<IV). *Occidozyga shiwandashanensis* **sp. nov.** differs from *O. tompotika* by: finger tips pointed; toe tips rounded, slightly expanded into disc; finger webbing absent; toe webbing full, but fourth toe not webbed to disc (vs. fingers and toes with wide expansions at tips; toes half webbed).

Remarks: Our preliminary phylogenetic analyses supported the monophyly of *Occidozyga*, consistent with the results of Flury et al. (2021) and Matsui et al. (2021). However, species relationships within the genus *Occidozyga* were unresolved due to a lack of robust support. Flury et al. (2021) suggested that *Occidozyga* species diversity is likely underestimated. Previous large-scale sampling revealed 29 evolutionary lineages based on a species delineation threshold of 5% mitochondrial 16S genetic divergence (Flury et al., 2021; Köhler et al., 2021; Matsui et al., 2021). Our results were considerably larger (vs. >13%) than those of Flury et al. (2021), indicating that the new species is valid.

Following the phylogenetic analyses of Flury et al. (2021), Frost (2021) suggested that the genus *Occidozyga* contains 15 recognized species. Flury et al. (2021) also argued that *Limnnectes rhacodus* (Inger et al., 1996) needs to be transferred to the genus *Occidozyga* based on phylogenetic trees. However, Matsui et al. (2021) stated that their specimens from Sarawak, Malaysia, differed from *L. rhacodus* from the type locality (Kalang River, Indonesia) in mandible shape. The *L. rhacodus* holotype (MZB 2991) has a single median and two lateral cusps on the mandible, while the Sarawak specimens have a single median cusp (Matsui et al., 2021). Thus, due to the misidentification of specimens, Flury et al. (2021) transferred *L. rhacodus* to the genus *Occidozyga*, which was followed by Frost (2021). Given the distinct morphological characters of the specimens from Matang Range (Sarawak, Malaysia), Matsui et al. (2021) finally

described them as a new member of the genus *Occidozyga*, namely, *O. berbeza*.

Occidozyga lima and *O. martensii* are widespread species in southern and southwestern China (Che & Wang, 2016). At Mt. Shiwandashan, the new species is sympatric with *O. lima* and *O. martensii*. However, *O. lima* and *O. martensii* primarily inhabit rice paddies and other wet agricultural areas. To the best of our knowledge, the new species only occurs in forested areas. Thus, further research is required to clarify the true range and ecological characters of the new species, which are critical for assessing its conservation status.

NOMENCLATURAL ACTS REGISTRATION

The electronic version of this article in portable document format represents a published work according to the International Commission on Zoological Nomenclature (ICZN), and hence the new names contained in the electronic version are effectively published under that Code from the electronic edition alone (see Articles 8.5–8.6 of the Code). This published work and the nomenclatural acts it contains have been registered in ZooBank, the online registration system for the ICZN. The ZooBank LSIDs (Life Science Identifiers) can be resolved and the associated information can be viewed through any standard web browser by appending the LSID to the prefix <http://zoobank.org/>.

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SCIENTIFIC FIELD SURVEY PERMISSION INFORMATION

Permission for field surveys was granted by the Administration Bureau of Shiwandashan National Nature Reserve of Guangxi (No. SWDS2021012).

SUPPLEMENTARY DATA

Supplementary data to this article can be found online.

COMPETING INTERESTS

The authors declare that they have no competing interests.

AUTHORS' CONTRIBUTIONS

W.C.C. and Y.M.M. conceived and designed the study and prepared the manuscript. W.C.C. and Z.H. measured the specimens. W.C.C. performed the molecular experiments and analyzed the data. W.C.C., W.X.P., Y.J.L., Z.H., X.W.L., and Y.M.M. conducted field surveys. All authors read and approved the final version of the manuscript.

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REFERENCES

- Chan KO, Schoppe S, Rico ELB, Brown RM. 2021. Molecular systematic investigation of Philippine puddle frogs (Anura: Dicroglossidae: *Occidozyga* Kuhl and Van Hasselt, 1822) reveals new candidate species and a novel pattern of species dyads. *Philippine Journal of Systematic Biology*, **14**(2): 1–14.
- Che J, Wang K. 2016. AmphibiaChina: an online database of Chinese Amphibians. *Zoological Research*, **37**(1): 57–59.
- Flury JM, Haas A, Brown RM, Das I, Pui YM, Boon-Hee K, et al. 2021. Unexpectedly high levels of lineage diversity in Sundaland puddle frogs (Dicroglossidae: *Occidozyga* Kuhl and van Hasselt, 1822). *Molecular Phylogenetics and Evolution*, **163**: 107210.
- Frost DR. 2021 (2021-09-08). Amphibian species of the world 6.1, an online reference. New York, USA: American Museum of Natural History, <https://amphibiansoftheworld.amnh.org/index.php>.
- Gravenhorst JLC. 1829. Deliciae musei zoologici vratslaviensis. Fasciculus primus. Chelonios et batrachia. Lipsiae: Leopold Voss, 17.
- Inger RF, Boeadi, Taufik A. 1996. New species of ranid frogs (Amphibia: Anura) from central Kalimantan, Borneo. *Raffles Bulletin of Zoology*, **44**(2): 363–369.
- Köhler G, Vargas J, Than NL, Schell T, Janke A, Pauls SU, et al. 2021. A taxonomic revision of the genus *Phrynoglossus* in Indochina with the description of a new species and comments on the classification within Occidozyginae (Amphibia, Anura, Dicroglossidae). *Vertebrate Zoology*, **71**: 1–26.
- Kuhl H, van Hasselt JC. 1822. Uittreksels uit breieven van de Heeren Kuhl en van Hasselt, aan de Heeren C. J. Temminck, Th. van Swinderen en W. de Haan. *Algemeene Konst-en Letter-Bode*, **7**: 99–104.
- Matsui M, Kuraishi N, Jiang JP, Ota H, Hamidy A, Orlov NL, et al. 2010. Systematic reassessments of fanged frogs from China and adjacent regions (Anura: Dicroglossidae). *Zootaxa*, **2345**(1): 33–42.
- Matsui M, Nishikawa K, Eto K, Hamidy A, Hossman Y, Fukuyama I. 2021. A new *Occidozyga* from Sarawak, Malaysian Borneo (Anura: Dicroglossidae). *Zootaxa*, **4926**(4): 535–546.
- Trageser S, Al-Razi H, Maria M, Nobel F, Asaduzzaman M, Rahman SC. 2021. A new species of *Phrynoglossus* (Peters, 1867; Dicroglossidae) from southeastern Bangladesh, with comments on the genera *Occidozyga* and *Phrynoglossus*. *PeerJ*, **9**: e11998.