A NEW CRYPTOIC SPECIES OF THE GENUS Microhyla (AMPHIBIA: MICROHYLIDAE) FROM LANGBIAN PLATEAU, VIETNAM

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Abstract
An integrative taxonomic analysis combining molecular and morphological lines of evidence revealed a new cryptic species of the Microhyla achatina species group from the Langbian Plateau of southern Vietnam. The new species was previously confused with its recently described morphologically similar and sympatric sister species, M. pineticola. The new species can be distinguished from M. pineticola by the presence of a continuous dark stripe running from the posterior edge of its eye towards the groin (vs dark markings interrupted above the axilla), snout acuminate in lateral profile (vs rounded), belly colour pattern, and foot webbing. The new species is currently known only from Bidoup–Nui Ba National Park in Lam Dong Province, Langbian Plateau in southern Vietnam (at elevations of 1300–1600 m a.s.l.). We suggest the new species to be considered as Near Threatened (NT) in the IUCN Red List. Our results emphasize that our understanding of the diversity of genus Microhyla is still far from complete, and provide further evidence for montane areas of southern Vietnam to be a centre of Microhyla species richness. Our study further underscores the urgent need for intensified integrative taxonomic research on Microhyla spp. in order to clarify the taxonomy of wide-ranging species complexes and to elaborate effective conservation measures.

Key words: Bidoup–Nui Ba National Park, Microhyla pineticola, mtDNA, sympathy, taxonomy.

Introduction
The genus Microhyla Tschudi, 1838 currently contains 52 nominal species of small-sized to tiny terrestrial frogs distributed from the Ryukyus (Japan) and southern China, southward through Southeast Asia to India and Sri Lanka (Frost 2020; Gorin et al. 2020; Poyarkov et al. 2020a,b). Nearly one half (23 species) of the recognised members of this diverse genus has been described within the last 10 years (Frost 2020). Nevertheless the taxonomy of Microhyla remains challenging, owing to logistical problems associate with their small size. Taxonomic progress in Microhyla is further hampered by the independent evolution of miniaturization observed in several lineages and the resulting high degree of convergent morphological similarity (Gorin et al. 2020).
This, along with the common sympatric occurrences of closely-related cryptic species and widely distributed complexes comprised of highly divergent lineages (Garg et al. 2018; Gorin et al. 2020), make the genus Microhyla one of the most taxonomically challenging groups of Asian frogs. Thus, the application of molecular phylogenetics is crucial for the construction of a proper taxonomy and understanding the diversity within Microhyla (Gorin et al. 2020).

The Pine narrow-mouth frog, Microhyla pineticola Poyarkov, Vassilieva, Orlov, et al., 2014 was described from Bidoup–Nui Ba National Park in Lam Dong Province, Langbian Plateau in southern Vietnam. In their study, Poyarkov et al. (2014) revised the Microhyla fauna of Vietnam based entirely on morphological evidence, and distinguished M. pineticola from the morphologically similar M. heymonsi Vogt, 1911, a widely distributed species found throughout Indochina. A more recent comprehensive review of Microhyla diversity and phylogenetic relationships (Gorin et al. 2020) confirmed the genetic distinctiveness of M. pineticola from M. heymonsi, and assigned both species to the M. achatina species group (group A in Gorin et al. 2020). According to the original description, M. pineticola is characterized by: a small dark round spot at the mid-dorsum divided by a light vertebral stripe and dorsal markings formed by dark-brown lines outlined in beige, parallel to the vertebral and dorsolateral stripes, forming a pattern resembling the grain of pinewood (Poyarkov et al. 2014). Poyarkov et al. (2014) reported significant variation in colouration within the type series of M. pineticola, which included specimens lacking the characteristic lines on dorsum, and specimens having a dark line extending from the posterior margin of the eye towards the flanks and groin which may or may not be continuous be interrupted above the axilla (see variation section in Poyarkov et al. 2014: 103–104). However, additional data on the morphological variation and the molecular differentiatin of the populations assigned to M. pineticola were lacking.

While collecting genetic data for the phylogenetic reconstruction by Gorin et al. (2020), we discovered that the samples of M. pineticola were represented by two highly divergent haplotypes (only one of which was included in the final analysis of Gorin et al. 2020). In the present study we apply an integrative taxonomic approach, comparing the results of morphological analyses with those of phylogenetic analyses using mitochondrial (mtDNA) sequences (12S rRNA–16S rRNA fragment) to analyze differentiation between M. pineticola populations from Lam Dong Province and the newly discovered population from Dak Lak Province of southern Vietnam. We demonstrate that the type series of M. pineticola is comprised of two superficially similar yet genetically different cryptic lineages of individuals. Additional examination of the type series and newly collected material resulted in the discovery of stable character state differences in colouration and external morphology between the two lineages which are concordant with the results of the molecular phylogenetic analyses. Herein, we reassess the taxonomic status of the two lineages masquerading under the name ‘M. pineticola’: one is redescribed as M. pineticola s. str., while the second we describe as a new, previously overlooked, cryptic species of Microhyla.

Material and methods
Sample collection: We examined the type series of Microhyla pineticola stored in the Zoological Museum of Moscow University (Moscow, Russia; hereafter given as ZMMU), including the holotype specimen (ZMMU A-5043). Additional specimens were collected from Lam Dong and Dak Lak provinces, southern Vietnam, during several field surveys in 2009–2014 (Table 1). The locations of the surveyed localities and the distribution of M. pineticola complex members in Vietnam are shown in Fig. 1. Geographic coordinates and elevations were obtained using a Garmin GPSMAP 60CSx (WGS 84 datum). Specimens were fixed in 10% buffered formalin after tissue samples were preserved in 95% ethanol. Specimens were later transferred to 70% ethanol. Newly collected specimens and tissues were subsequently deposited in the herpetological collections of ZMMU (Moscow, Russia).

Morphological description: Specimens of the Microhyla pineticola complex were photographed in life and after preservation. Measurements were taken using a digital caliper to the nearest 0.01 mm and rounded to 0.1 mm. We used an Olympus stereoscopic light binocular microscope when necessary. All measurements were taken on the right side of the specimen. The morphometrics of adults and character terminology followed Poyarkov et al.
(2014, 2019a, 2020a,b) and included the following measurements: snout–vent length (SVL; measured from tip of snout to cloaca); head length (HL; measured from tip of snout to hind border of jaw angle); snout length (SL; measured from anterior margin of eye to tip of snout); eye length (EL; measured as the distance between anterior and posterior margins of the eye); nostril–eye length (N–EL; measured as the distance between the anterior margin of the eye and the nostril centre); head width (HW; measured as the maximum width of the head at the level of mouth angles in ventral view); internarial distance (IND; measured as the distance between central points of nostrils); interorbital distance (IOD; measured as the shortest distance between medial edges of eyeballs in dorsal view); upper eyelid width (UEW; measured as the maximum distance between medial edge of eyeball and lateral edge of upper eyelid); forelimb length (FLL; measured as the length of straightened forelimb to tip of third finger); lower arm and hand length (LAL; measured as the distance between elbow and tip of third finger); hand length (HAL; measured as the distance between proximal end of outer palmar (metacarpal) tubercle and tip of third finger); first finger length (1FL; measured as the distance between tip and distal end of inner palmar tubercle); inner palmar tubercle length (IPTL; measured as the maximum distance between proximal and distal ends of inner palmar tubercle); outer palmar tubercle length (OPTL; measured as the maximum diameter of outer palmar tubercle); third finger disc diameter (3FDD); hindlimb length (HLL; measured as the length of straightened hindlimb from groin to tip of fourth toe); tibia length (TL; measured as the distance between knee and tibiotarsal articulation); foot length (FL; measured as the distance between distal end of tibia and tip of fourth toe); inner metatarsal tubercle length (IMTL; measured as the maximum length of inner metatarsal tubercle); first toe length (1TOEL), measured as the distance between distal end of inner metatarsal tubercle and tip of first toe; third toe disc diameter (3TDD); outer metatarsal tubercle length (OMTL; measured as the maximum length of outer metatarsal tubercle). Additionally, we took the following measurements for the holotype description: second to fourth finger lengths (2–3FLO, 4FL-I; for outer side (O) of the second and third, and inner side (I) of the fourth, measured as the distance between the tip and junction of the neighboring finger); second to fifth toe lengths (measured as the outer lengths for toes II–IV, as the inner length for toe V; 2–5TOEL); finger disc diameter for fingers I–II and IV (1–2FDD, 4FDD); toe disc diameter for toes I–II and IV–V (1–2TDD, 4–5TDD). Toe webbing and subarticular tubercle formulas were given following Savage (1975). The sex and maturity of the specimens was checked by minor dissections and by direct observations of calling behaviour in living males prior to collection.

The diagnosis of the genus *Microhyla* and morphological characters for comparison were taken from original descriptions and taxonomic reviews from: Atmaja *et al.* (2019); Bain & Nguyen (2004); Biju *et al.* (2019); Das & Haas (2010); Das *et al.* (2007); Garg *et al.* (2018); Hasan *et al.* (2014); Hoang *et al.* (2020); Howlader *et al.* (2015); Khatiwada *et al.* (2017); Matsui (2011); Matsui *et al.* (2013); Matsui & Tomiaga (2020); Nguyen *et al.* (2019); Li *et al.* (2019); Parker (1928); Pillai (1977); Poyarkov *et al.* (2014, 2019a, 2020a,b); Vineeth *et al.* (2018); Wijayathilaka *et al.* (2016); Zhang *et al.* (2018).

**Laboratory methods:** Total genomic DNA was extracted from ethanol-preserved femoral muscle tissue or liver tissue using a standard phenol–chloroform–proteinase K extraction protocol with consequent isopropanol precipitation (Hillis *et al.* 1996). Isolated...
genomic DNA was visualized in agarose electrophoresis in the presence of ethidium bromide; total DNA concentration was measured in 1 μL using NanoDrop 2000 (Thermo Scientific), and consequently adjusted to 175 ca. 100 ng DNA/μL. We amplified an mtDNA fragment partially covering the 12S rRNA–16S rRNA genes and the complete sequence of tRNA-Val resulting in a continuous fragment 2399 bp in length. These markers have proven to be particularly useful in phylogenetic and taxonomic studies of the genus Microhyla (e.g. Matsui 2011; Hasan et al. 2012, 2014; Matsui et al. 2013; Wijayathilaka et al. 2016; Poyarkov et al. 2019a, 2020b; Gorin et al. 2020). DNA amplification was performed in 20-μL reactions using ca. 50 ng genomic DNA, 10 nmol of each primer, 15 nmol of each dNTP, 50 mM additional MgCl2, Taq PCR buffer (10 mM Tris-HCl, pH 8.3, 50 mM KCl, 1.1 mM MgCl2 and 0.01% gelatine) and 1 U of 185 Taq DNA polymerase. Primers used in PCR and sequencing, along with the PCR conditions followed Gorin et al. (2020). The PCR products were loaded onto 1.5% agarose gels in the presence of ethidium bromide and visualised in electrophoresis. The successful targeted PCR products were outsourced to Evrogen® (Moscow, Russia) for PCR purification and sequencing. Sequence data collection and visualisation were carried out on an ABI 3730xl Automated Sequencer (Applied Biosystems). The newly obtained sequences were deposited in GenBank under accession numbers MW147155–MW147166 and MW147168–MW147172 (Table 1).

Phylogenetic analyses: The 12S rRNA–16S rRNA Microhylidae data set of Gorin et al. (2020) with the addition of a sequence of the recently described M. hongiaoensis Hoang, Luong, Nguyen et al. 2020 and our newly obtained sequences were used to reconstruct a matrilineal genealogy of Microhyla. The initial data set was pruned to one sequence per species, with the exception of M. pineticola and the morphologically similar Microhyla sp. from southern Vietnam. In total, 12S rRNA–16S rRNA data for 93 specimens were included in the final analysis, including 64 samples of ca. 53 Microhyla species (representing all recognized species within the genus), 28 outgroup sequences of other microhylid representatives, and a sequence of Rhacophorus schlegelii (Günther, 1858), which was used to root the tree (Table 1). We initially aligned the nucleotide sequences in MAFFT v. 6 (Katoh et al. 2002) with default parameters, and subsequently slightly adjusted it in BioEdit v. 7.0.5.2 (Hall 1999). The mean uncorrected genetic distances (p-distances) between individuals were estimated in MEGA 6.0 (Tamura et al. 2013). We used IQ-TREE webserver (Nguyen et al. 2015; Trifinopoulos et al. 2016) to estimate the optimal evolutionary models for the subsequent analyses. The best-fitting models of DNA evolution were GTR+I +G, JC+G and GTR+G, for 12S rRNA, tRNA-Val and 16S rRNA genes, respectively, as suggested by the Akaike information criterion (AICc).

We inferred the matrilineal genealogy using Maximum Likelihood (ML) and Bayesian Inference (BI) approaches. We conducted ML analysis in the IQ-TREE webserver. One-thousand bootstrap pseudoreplicates via the ultrafast bootstrap (UFBS; Hoang et al. 2018) approximation algorithm were employed and nodes having ML UFBS values of 95 and above were considered highly supported, while the nodes with values of 90–94 were considered well-supported (Bui et al. 2013). We implemented the BI analysis in MrBayes v. 3.1.2 (Ronquist & Huelsenbeck 2003). We ran Metropolis-coupled Markov chain Monte Carlo (MCMC) analyses with one cold and three heated chains for 20 million generations and sampled every 2,000 generations. The two independent MCMC runs were performed; we checked that the effective sample sizes (ESSs) were all above 200 by exploring the likelihood plots using TRACER v. 1.6 (Rambaut et al. 2014). The initial 1000 trees were discarded as burn-in. The confidence in tree topology was assessed by the frequency of nodal resolution (posterior probability; BI PP) (Huelsenbeck & Ronquist 2001). We regarded tree nodes with BIPP values over 0.95 to be strongly supported; values between 0.95 and 0.90 were regarded as moderately supported; while the lower values were considered to have no nodal support (Huelsenbeck & Hillis 1993).

Results

Sequence variation: Among the 2399 bp of the final 12S rRNA–16S rRNA alignment, 1295 sites were conserved, while 1101 sites exhibited variation, of which 847 were parsimony informative. The transition–transversion bias (R) was estimated as 2.11. Nucleotide frequencies were A = 33.60%, T = 24.30%, C = 23.63%, and G = 18.47% (data given for ingroup only).
MtDNA genealogy: The ML and BI analyses resulted in identical topologies, which differed only in a non-supported node of the basal radiation of Microhyla (Fig. 2). Both analyses achieved high resolution of phylogenetic relationships among Microhyla species and all major nodes in the tree were sufficiently resolved (UFBS≥95%; PP≥0.95). Overall, our updated mtDNA genealogy was largely consistent with the phylogeny of Gorin et al. (2020), suggesting strong support for monophyly of the Microhyla–Glyphoglossus assemblage (100/1.0; hereafter nodal support values given for UFBS/PP, respectively), and no support for Microhyla monophyly (53/-). Within the Microhyla–Glyphoglossus assemblage, ten major clades / lineages were recovered, generally agreeing with the results of Gorin et al. (2020) (Fig. 2, hereafter species group names follow Gorin et al. 2020). Clade A consisted of 15 morphospecies of the M. achatina species group, including M. achatina Tschudi, 1838; M. heymonsi; M. borneensis Parker, 1928; M. gadjahmadai Atmaja, Hamidy, Arisuryanti et al., 2018; M. irrawaddy Poyarkov, Gorin, Zaw et al. 2019; M. kodial Vineeth, Radhakrishna, Godwin et al., 2018; M. malang Matsui, 2011; M. manthayi Das, Yaakob & Sukumaran, 2007; M. minuta Poyarkov, Vassilieva, Orlov et al., 2014; M. nepenthicola Das & Haas, 2010; M. orientalis Matsui, Hamidy & Eto, 2013; the two undescribed species-level lineages Microhyla sp. 1 from Sarawak, Malaysia, and Microhyla sp. 2 from Sagaing, Myanmar, and the two lineages of ‘M. pineticola’ from southern Vietnam (Fig. 2, Clade A). The phylogenetic relationships and taxonomic content of other species groups (Clades B–J) fully agreed with the results of Gorin et al. (2020), including the M. fissipes group (Clade B), the M. berdmorei group (Clade D), the M. superciliaris group (Clade E), the M. ornata group (Clade F), the M. butleri group (Clade G), M. palmipes Boulenger (Clade H), the M. annectens group (Clade I), and Glyphoglossus Günther (Clade J) (see Fig. 2 for details). The only important difference from the taxonomic arrangement by Gorin et al. (2020) is the phylogenetic position of M. fodiens Poyarkov, Gorin, Zaw et al., 2019 from Myanmar, which was earlier provisionally assigned to the M. achatina species group (Poyarkov et al. 2019a; Gorin et al. 2020). In our mtDNA-genealogy M. fodiens is an orphaned species, suggested as a sister lineage (100/1.0) to the moderately supported clade joining the members of M. achatina species group + M. fissipes groups (93/0.62) (Fig. 2, Clade C). Genealogical relationships within the M. achatina species group were generally sufficiently resolved, suggesting that all members of this group with the exception of M. heymonsi and ‘M. pineticola’ form a strongly supported clade (100/1.0), joining species from Sundaland, Myanmar, and southern India. The only Vietnamese taxon in this clade is M. minuta and it is distantly related to the other species. The wide-ranging M. heymonsi formed a strongly supported ML clade with ‘M. pineticola’ from southern Vietnam, but and unsupported clade in in the BI analysis (97/0.89).

Our analysis strongly suggested that ‘M. pineticola’ from southern Vietnam is represented by two, highly divergent, reciprocally monophyletic, sympatric lineages (100/1.0). One lineage corresponds to M. pineticola sensu stricto and includes the holotype of M. pineticola (ZMMU A-5043), two paratypes (ZMMU A-5080, A-4331) (all three specimens from Bidoup–Nui Ba National Park, Lam Dong Province; Fig. 1, locality 1), and two newly collected specimens from Chu Yang Sin National Park, Dak Lak Province (ZMMU A-6029, A-7269; Fig. 1, locality 2) (Fig. 2). The other lineage includes eight specimens from the same area of Bidoup–Nui Ba National Park as the M. pineticola holotype—all of which were indentified by Poyarkov et al. (2014) as paratypes of ‘M. pineticola’ (originally listed under numbers ZMMU A-4331 and A-5080; new numbers ZMMU A-7302–7306, A-7308, A-7310–7311) (Fig. 2).

Genetic distances: The uncorrected p-distances for the 16S rRNA mtDNA fragment among the members of the M. achatina species group are shown in Table 2. The interspecific distances among the members of the M. achatina species group varied from p=2.2% (between M. irrawaddy and Microhyla sp. 2) to p=14.5% (between M. fodiens and M. borneensis). The two lineages of ‘M. pineticola’ showed a significant level of genetic distinctiveness (p=5.2%) between them and both were found to be most closely related to their putative sister species M. heymonsi (p=7.0–8.7%). Genetic differentiation among the examined samples of M. pineticola s. str. and the second lineage of ‘M. cf. pineticola’ from Bidoup–Nui Ba National Park was minimal (uncorrected within-group p-distance 0.1% and 0.4%, respectively) (Table 2).
### Table 1. Sequences and voucher specimens of Microhyla and outgroup taxa used in this study: NP, National Park; FR, Forest Reserve; Is., Island; Mt. Mountain; H, holotype; — not available.

| Species                     | Locality                              | Museum / Sample ID | 12S rRNA          | 16S rRNA          | Reference          |
|-----------------------------|---------------------------------------|--------------------|-------------------|-------------------|--------------------|
| **Ingroup**                 |                                       |                    |                   |                   |                    |
| Microhyla achatina          | Indonesia, Java, Ujung Kulon          | ZMMU A-5070        | MN534670          | MN534462, MN534563| Gorin et al. 2020  |
| Microhyla annamensis        | Vietnam, Lam Dong, Bidoup-Nui Ba NP   | ZMMU A-5075-06     | MN534748          | MN534533, MN534639| Gorin et al. 2020  |
| Microhyla ameuctens         | Malaysia, Selangor, Genting           | ZMMU A-6042-1      | MN534746          | MN534531, MN534637| Gorin et al. 2020  |
| Microhyla arboricola        | Vietnam, Dak Lak, Chu Yang Sin NP     | ZMMU A-4845-60     | MN534759          | MN534543, MN534650| Gorin et al. 2020  |
| Microhyla aurantiovirens    | Vietnam, Gia Lai, Kon Ka Kinh NP     | ITBCZ-4360         | MN534727          | MH286427          | Nguyen et al. 2019; Gorin et al. 2020 |
| Microhyla beihimensis       | China, Sichuan                        | CIB 20070248       | AB634611          | AB634669          | Matsui et al. 2011 |
| Microhyla berdmorei         | Thailand, Suratthani, Khao Sok NP     | ZMMU NAP-04133     | MN534711          | MN534503, MN534604| Gorin et al. 2020  |
| Microhyla borneensis        | Bangladesh, Mymensingh                | ZISP 13874         | MN534698          | MN534490, MN534591| Gorin et al. 2020  |
| Microhyla butleri           | Bangladesh, Chittagong                | BNHS 5965          | --                | --                | Garg et al. 2018   |
| Microhyla darreli           | India, Kerala, Thiruvananthapuram    | ZSI/WGREC/V/A/962  | --                | MH807390          |                    |
| Microhyla eos               | India, Ananalach Pradesh, Namdapa NP | ZSIC 14312         | --                | MN160599          | Bij et al. 2019    |
| Microhyla fodiens           | Myanmar, Magway, Kan Pauk            | ZMMU A-5960        | MK208926          |                   | Gorin et al. 2020  |
| Microhyla gadjahmadai       | Indonesia, Sumatra, Lampung          | MZB Amp 15291      | AB634622          | AB634680          | Matsui et al. 2011 |
| Microhyla heymonsi          | Taiwan, Pingtong, Yongchin, Qi Kong  | ZMMU A-4975        | MN534679          | MN534471, MN534572| Gorin et al. 2020  |
| Microhyla hongioensis       | Vietnam, Lam Dong, Bidoup-Nui Ba NP  | CIB-VNMN 07617     | --                | MN475176          | Hoang et al. 2020  |
| Microhyla irrawaddi         | Myanmar, Magway, Pakkoku             | ZMMU A-5966        | MK208928          |                   | Gorin et al. 2020  |
| Microhyla karunanatnei      | Sri Lanka, Sinharaja FR               | released           | MN534738          | MN534524, MN534629| Gorin et al. 2020  |
| Microhyla kodial            | India, Karnataka, Mangaluru          |                    | --                | MF919454          | Vineeth et al. 2018|
| Microhyla kuramotai         | Japan, Okinawa, Ishigaki Is.         | released           | MN534700          | MN534492, MN534593| Gorin et al. 2020  |
| Microhyla laterite          | India, Karnataka, Udupi, Manipal     | BNHS 5965          | KT600670          | KT600663          | Seshadri et al. 2016|
| Microhyla makeng            | Malaysia, Sarawak, Kubah NP          | ZMMU A-6043        | MN534662          | MN534454, MN534555| Gorin et al. 2020  |
| Microhyla manthevi          | Malaysia, Taman Negara NP            | ZMMU NAP-6745      | MN534665          | MN534457, MN534558| Gorin et al. 2020  |
| Microhyla marmorata         | Vietnam, Kon Tum, Kon Pong           | ZPMSU 04854        | MN534750          | MN534535, MN534641| Gorin et al. 2020  |
| Microhyla midhitalae        | Sri Lanka, Rathambhalmi              | released           | MN534726          | MN534515, MN534619| Gorin et al. 2020  |
| Microhyla minuta            | Vietnam, Dong Nai, Cat Tien NP       | ZMMU A-5048-91     | MN534667          | MN534459, MN534560| Gorin et al. 2020  |
| Microhyla mixtura           | China, Sichuan, Wanyuan, Mt. Hua’eshan | CIB 20170526001   | MH234529          | MH234540          | Zhang et al. 2018  |
| Microhyla mokhleuri         | Bangladesh, Chittagong               | IABHU-39/59        | MN534692          | MN534484, MN534585| Gorin et al. 2020  |
| Microhyla mymensinghensis   | Bangladesh, Mymensingh               | IABHU-41/29        | MN534699          | MN534491, MN534592| Gorin et al. 2020  |
| Microhyla nanapolex         | Vietnam, Kon Tum, Kon Pong           | ZMMU A-5635        | MN534757          | MN534541, MN534648| Gorin et al. 2020  |
| Microhyla neglecta sp. nov. | Vietnam, Lam Dong, Bidoup-Nui Ba NP  | ZMMU A-7303         | MW147168          | MW147155          | this work          |
| Microhyla neglecta sp. nov. | Vietnam, Lam Dong, Bidoup-Nui Ba NP  | ZMMU A-7302         | --                | MW147160          | this work          |
| Microhyla neglecta sp. nov. | Vietnam, Lam Dong, Bidoup-Nui Ba NP  | ZMMU A-7308         | --                | MW147159          | this work          |
| Microhyla neglecta sp. nov. | Vietnam, Lam Dong, Bidoup-Nui Ba NP  | ZMMU A-7311         | --                | MW147158          | this work          |
| Microhyla neglecta sp. nov. | Vietnam, Lam Dong, Bidoup-Nui Ba NP  | ZMMU A-7305         | --                | MW147156          | this work          |
| Microhyla neglecta sp. nov. | Vietnam, Lam Dong, Bidoup-Nui Ba NP  | ZMMU A-7306         | --                | MW147157          | this work          |
| Microhyla neglecta sp. nov. | Vietnam, Lam Dong, Bidoup-Nui Ba NP  | ZMMU A-7310         | --                | MW147161          | this work          |
| Species | Museum / Sample ID | Genbank Acc. | Museum / Sample ID | Genbank Acc. | Museum / Sample ID | Genbank Acc. | Museum / Sample ID | Genbank Acc. |
|---------|-------------------|--------------|-------------------|--------------|-------------------|--------------|-------------------|--------------|
| TAPROBANICA 42 | | | | | | | | |
| Kalophrynus yongi | | | | | | | | |
| Kalophrynus pleurostigma | | | | | | | | |
| Gastrophrynoides immaculatus | | | | | | | | |
| Gastrophryne olivacea | | | | | | | | |
| Gastrophryne carolinensis | | | | | | | | |
| Dyscophus insularis | | | | | | | | |
| Chaperina fusc | | | | | | | | |
| Outgroups | | | | | | | | |
| G. yunnanensis | | | | | | | | |
| Glyphoglossus molossus | | | | | | | | |
| Glyphoglossus minutus | | | | | | | | |
| Glyphoglossus guttulatus | | | | | | | | |
| | | | | | | | | |
| Microhyla zeylanica | | | | | | | | |
| Microhyla tetrix | | | | | | | | |
| Microhyla tarai | | | | | | | | |
| Microhyla superciliaris | | | | | | | | |
| Microhyla rubra | | | | | | | | |
| Microhyla pulchra | | | | | | | | |
| Microhyla pulchella | | | | | | | | |
| Microhyla pineticola | | | | | | | | |
| Microhyla petrigena | | | | | | | | |
| Microhyla perparva | | | | | | | | |
| Microhyla palmi | | | | | | | | |
| Microhyla ornata | | | | | | | | |
| Microhyla orientalis | | | | | | | | |
| Microhyla okinavensis | | | | | | | | |
| Microhyla nilphamariensis | | | | | | | | |
| Microhyla neglecta | | | | | | | | |
| | | | | | | | | |
Table 1 continued. Sequences and voucher specimens of Microhyla and outgroup taxa used in this study; NP, National Park; — not available.

| Species         | Locality                          | Museum / Sample ID | 12S rRNA | 16S rRNA | Reference |
|-----------------|-----------------------------------|--------------------|----------|----------|-----------|
| Kaloula baleata | Indonesia, Sumba                  | KUHE 32313         | AB634629 | AB634687 | Matsui et al. 2011 |
| Kaloula rugfera | China                             | —                  | —        | —        | Deng et al. 2016 |
| Metaphrynella pollicaris | Malaysia, Pahang, Fraser’s Hill                  | KUZ 21655 | AB634634 | AB634692 | Matsui et al. 2011 |
| Metaphrynella sundana | Malaysia, Borneo, Sabah, Crocker            | BORN 8191 | AB634635 | AB634693 | Matsui et al. 2011 |
| Micryletta inornata | Thailand, Phrae, Mae Yom | KUHE 20497 | AB598317 | AB598341 | Matsui, 2011 |
| Micryletta nigromaculata | Vietnam, Hai Phong, Cat Ba NP               | ZMMU A-5934 | MH756150 | —        | Poyarkov et al. 2018; Gorin et al. 2020 |
| Micryletta steinegeri | Taiwan, Yulin                  | KUHE 35937 | AB634638 | AB634696 | Matsui et al. 2011 |
| Oreophryn monticola | Indonesia, Bali, Batu Karu | MZB Amp 16265 | AB634651 | AB634709 | Matsui et al. 2011 |
| Otophyne robusta | Guyana, District 8, Mt. Wokomung | ROM 42963 | KM509171 | —        | Peloso et al. 2016 |
| Phrynella pulchra       | Malaysia, Trengganu, Hulu Trengganu       | UKMHC 820 | AB634636 | AB634694 | Matsui et al. 2011 |
| Phrynomantis bifasciatus | Pet trade            | KUHE 33277 | AB634652 | AB634710 | Matsui et al. 2011 |
| Rhacophorus schlegelii | Japan, Hiroshima              | —                  | AB202078 | AB202078 | Sano et al. 2005 |
| Scaphiophryne gottlebei | Pet trade               | KUHE 34977 | AB634653 | AB634711 | Matsui et al. 2011 |
| Synapturanaus salseri | Brazil, Amazonas, Manaus | MZUSP | KM509207 | —        | Peloso et al. 2016 |
| Uperodon taprobanicus | Sri Lanka                        | KUHE 37252 | AB634633 | AB634691 | Matsui et al. 2011 |

Table 2. Uncorrected p-distance (percentage) between the sequences of 16S rRNA mtDNA fragment (below the diagonal), error estimates (above the diagonal), and intraspecific p-distance (on the diagonal) of the Microhyla achatina species group members included in phylogenetic analyses.

| Species          | 1     | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    | 11    | 12    | 13    | 14    | 15    | 16    |
|------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| M. neglecta sp. nov. | 0.4   | 0.9   | 1.1   | 1.6   | 1.1   | 1.3   | 1.3   | 1.2   | 1.3   | 1.3   | 1.3   | 1.3   | 1.3   | 1.3   | 1.4   | 1.4   |
| M. pinetica s. str.     | 5.2   | 0.1   | 1.1   | 1.5   | 1.0   | 1.1   | 1.0   | 1.2   | 1.2   | 1.3   | 1.3   | 1.3   | 1.3   | 1.3   | 1.3   | 1.3   |
| M. bennesi               | 8.7   | 7.0   | 1.6   | 1.1   | 1.2   | 1.1   | 1.0   | 1.0   | 1.1   | 1.0   | 1.1   | 1.0   | 1.4   | 1.4   | 1.4   | 1.4   |
| M. borneensis            | 13.1  | 12.5  | 11.9  | —     | 0.9   | 1.1   | 1.2   | 1.5   | 1.3   | 1.3   | 1.5   | 1.7   | 1.6   | 1.3   | 1.3   | 1.9   |
| M. nepenthica            | 10.3  | 8.3   | 7.8   | 3.0   | —     | 0.6   | 0.7   | 1.0   | 1.0   | 1.1   | 1.2   | 1.1   | 1.0   | 1.1   | 1.0   | 1.6   |
| Microhyla sp. 1 | 10.9  | 9.1   | 7.7   | 4.8   | 2.6   | —     | 0.8   | 1.1   | 1.0   | 1.2   | 1.1   | 1.2   | 1.1   | 1.2   | 1.0   | 1.4   |
| M. malang               | 10.1  | 8.3   | 7.3   | 5.6   | 2.2   | 3.5   | —     | 1.0   | 1.1   | 1.1   | 1.2   | 1.1   | 1.0   | 1.1   | 1.0   | 1.5   |
| M. orientalis           | 9.5   | 7.9   | 7.1   | 9.5   | 5.7   | 6.9   | 5.7   | —     | 1.0   | 1.1   | 1.1   | 1.2   | 1.0   | 0.9   | 1.0   | 1.5   |
| M. mantheyi             | 11.1  | 8.9   | 7.8   | 7.4   | 5.3   | 4.9   | 5.7   | 5.7   | —     | 1.0   | 1.1   | 1.0   | 1.0   | 0.9   | 1.1   | 1.4   |
| Microhyla sp. 2 | 11.3  | 9.7   | 7.7   | 11.3  | 8.4   | 8.6   | 8.2   | 8.0   | 7.7   | —     | 0.6   | 0.9   | 1.1   | 1.1   | 1.2   | 1.4   |
| M. trivialis            | 10.5  | 8.9   | 6.9   | 11.6  | 8.0   | 7.8   | 7.8   | 7.7   | 7.7   | 2.2   | —     | 0.9   | 1.2   | 1.1   | 1.2   | 1.4   |
| M. kodial               | 11.7  | 9.3   | 6.8   | 10.9  | 7.6   | 8.0   | 8.0   | 8.0   | 7.2   | 6.4   | 6.0   | —     | 1.1   | 1.2   | 1.4   | 1.4   |
| M. achatina             | 9.3   | 9.4   | 7.3   | 8.6   | 6.5   | 6.9   | 6.9   | 5.9   | 6.3   | 6.5   | 6.9   | 6.9   | 8.3   | —     | 0.8   | 1.1   |
| M. gadjahmadai          | 10.5  | 9.5   | 8.4   | 8.9   | 6.5   | 7.1   | 7.7   | 6.3   | 5.7   | 7.3   | 6.9   | 7.8   | 5.3   | —     | 0.9   | 1.5   |
| M. minuta              | 10.1  | 8.3   | 8.2   | 8.0   | 5.3   | 6.7   | 5.7   | 6.1   | 6.3   | 8.0   | 8.0   | 8.7   | 6.9   | 6.1   | —     | 1.5   |
| M. fodiens             | 10.3  | 10.0  | 9.6   | 14.5  | 12.2  | 12.0  | 12.2  | 12.0  | 11.0  | 11.8  | 11.6  | 12.4  | 10.6  | 11.6  | 11.0  | —     |
Figure 2. Maximum Likelihood tree of *Microhyla* derived from the analysis of 2399 bp of alignment including 12S rRNA, tRNA-Val and 16S rRNA gene fragments. For voucher specimen information and GenBank accession numbers see Table 1. Red and blue colours denote the new species and *M. pineticola* sensu stricto respectively, holotypes denoted with asterisks (*); grey denotes *M. achatina* species group members. Numbers at tree nodes correspond to UFBS/PP support values, respectively; well-supported nodes are marked with solid circle, moderate-support is indicated with empty circle, no circle means no-support; outgroup taxa are not shown; © Photos: Nikolay A. Poyarkov.
Systematics
Our molecular analyses of the type series of *Microhyla pineticola* and additional specimens, have demonstrated that specimens used in the original description actually belong to two sympatric mtDNA lineages. The specimens used in the *M. pineticola* description were collected in 2009, 2010 and 2011 in three locations within the Da NhIm River Valley, in the vicinity of Giang Ly Ranger Station of the Bidoup–Nui Ba National Park (ca. 2–4 km between the localities). The members of both lineages were sympatric.

Our mtDNA-based genealogy suggests that the two mtDNA lineages of ‘*M. pineticola*’ are sister lineages (Fig. 2). The level of divergence in 16S rRNA gene between these lineages is larger than would be expected within a single species ($p=5.2\%$). This value is much greater than the formal threshold of $p=3.0\%$, widely used as an indicator of species-level status in the surveys of anuran biodiversity (Vences et al. 2005a, 2005b; Vieites et al. 2009), and also exceeds minimal interspecific distances in the *M. achatina* species group (Table 2), and among *Microhyla* species in general (see Gorin et al. 2020).

Though the members of the two sympatric mtDNA-lineages of ‘*M. pineticola*’ are superficially similar in overall body habitus and have a variable dorsal pattern, a thorough reexamination of the material has revealed a number of stable differences in colouration, pattern, and body morphology (see Comparisons). These results were concordant with the observed genetic divergence and allowed us to readily distinguish the specimens belonging to the two different mtDNA lineages. Overall, the integrative taxonomic analyses strongly support our hypothesis that the original description of *M. pineticola* was based on the type series which included the members of two sister species of *Microhyla*, different both morphologically and genetically, and which were unnoticed by Poyarkov et al. (2014).

In the present paper the type series of *M. pineticola* is formally split in accordance with the International Code of Zoological Nomenclature (ICZN 1999); the former paratypes of *M. pineticola* (eleven specimens from ZMMU A-4331, three specimens from ZMMU A-5080) are below designated as holotype (new collection ID ZMMU A-7303) and paratypes (new collection IDs ZMMU A-7297–7302, ZMMU A-7304–7310) of the new species we describe herein. Below, we provide a detailed description and a revised diagnosis for *M. pineticola* sensu stricto, and describe the second lineage of ‘*M. cf. pineticola*’ from Bidoup–Nui Ba National Park as a new species.

Microhylide Günther, 1858

*Microhyla pineticola*

Poyarkov, Vassilieva, Orlov et al., 2014

Pine narrow-mouth frog
(Figs. 3, 4F; Tables 3, 4)

**Holotype.** Adult female, ZMMU A-5043 (field number NAP-01032), collected from Mt. Bidoup (12°957.24 N, 108°3944.28 E; alt. 1,800 m a.s.l.), Bidoup–Nui Ba National Park, Da NhIm River Valley, Da Chais Commune, Lac Duong District, Lam Dong Province, Vietnam, by N.A. Poyarkov on 01 May 2009 (see Poyarkov et al. 2014: 100).

**Paratypes (n=3):** adult males, ZMMU A-4331 (field number NAP-00414) and ZMMU A-4331 (field number NAP-00451); adult female, ZMMU A-5080 (field number NAP-01750); data same as that for the holotype (only those paratypes which proved to be conspecific to ZMMU A-5043 are listed here).

**Other materials examined (n=2):** adult male, ZMMU A-6029 (field number ABV-00579), collected from Chu Yang Sin National Park (12.413029° N, 108.367939° E; alt. 1,100 m a.s.l.), Dak Lak Province, Vietnam, by N.A. Poyarkov and A.B. Vassilieva on 23 May 2014; adult female, ZMMU A-7296 (field number ABV-00571), collected from Chu Yang Sin National Park (12.418742° N, 108.364608° E; alt. 970 m a.s.l.), Dak Lak Province, Vietnam, by N.A. Poyarkov on 22 May 2014.

**Revised diagnosis.** *Microhyla pineticola* is diagnosed by a combination of the following morphological attributes: body stocky, triangular, body size small (SVL 17.4–18.6 mm in males and 20.0–22.3 mm in females); dorsum feebly granular with small tubercles; head triangular, snout rounded in lateral profile (Fig. 4F); finger I short, less than one-half the length of finger II; tips of three outer fingers weakly dilated, forming weak discs, with a dorsal, median, longitudinal groove; tips of all toes distinctly dilated into discs, dorsally with a weak median longitudinal groove producing the appearance of two scutes; expanded toe discs less than twice...
Figure 3. *Microhyla pineticola* (A) dorsal view and (B) ventral view of the holotype (preserved), adult female, ZMMU A-5043 from Bidoup–Nui Ba NP, Lam Dong Province, Vietnam; (C) dorsal view, (D) ventral view, (E) plantar view of left foot, (F) volar view of left hand, and (G) lateral view of the head of an adult female (in life), ZMMU A-7296, from Chu Yang Sin NP, Dak Lak Province, Vietnam. © Photos Nikolay A. Poyarkov.
the width of phalanges; metacarpal tubercles two, both prominent and rounded; tibiotarsal articulation at straightened limb reaching beyond eye but not reaching snout tip; toe webbing basal, formula: I 1½-2½ II 1½-3 III 2½-3½ IV 4-2½ V; both inner and outer metatarsal tubercles present; upper eyelid without supraciliary spines; canthus rostralis with dark lines, top of snout well-differentiated in colour from the brown interorbital bar, which bears a dark spot; dark stripe running from the posterior edge of eye along the supratympanic fold, interrupted above the axilla (Figs. 3G, 4F), and continues to groin as a dark lateral stripe, clearly separating darker flanks and lighter dorsum; an indistinct beige stripe extending from posterior margin of eye to axilla; the axillary region and upper lips bearing numerous bluish-white speckles; light-coloured thin, vertebral stripe present; a small, dark, rounded, middorsal spot, divided by a light-coloured vertebral stripe; dorsal markings formed by dark-brownish lines parallel to vertebral and dorsolateral stripes, narrowly outlined in beige, forming a pattern resembling the grain of pinewood (Figs. 3A–B); chin dark-greyish with orange speckles and a thin light-coloured medial stripe continuing to chest and belly (Figs. 3B, D); two white lines extend along the ventral surfaces of forelimbs reach the chest and meet on the midline of the belly; belly purplish-grey with indistinct whitish mottingling.

Description of holotype. See Poyarkov et al. (2014). Measurements and morphological characters of the holotype and paratype series of this species are given in Table 3. The brief tadpole description presented by Poyarkov et al. (2014: 104–105, Fig. 13) may actually correspond to the larvae of the new species.

Distribution. To date known at elevations from 970 m a.s.l. in Chu Yang Sin National Park (Dak Lak Province) to 1800 m a.s.l. in Bidoup–Nui Ba National Park (Lam Dong Province). This species seems to be restricted to polydominant evergreen montane forests with a predominance of Pinus kremppii Lecomte (Family Pinaceae), Lithocarpus sp., Castanopsis sp., and Quercus sp. (all Family Fagaceae); and dry monodominant pine forests formed mostly by P. kesiya Royle ex Gordon (Family Pinaceae) on the Langbian Plateau (see Poyarkov et al. 2014). Based on known distribution, habitat and elevation preferences, Microhyla pineticola is likely endemic to the Langbian Plateau, southern Vietnam (Fig. 1).

Microhyla neglecta sp. nov. [urn:lsid:zoobank.org:act:22E3B2D0-A6BB-45C7-8A7A-87ADF2B17E9E] (Figs. 4A–E; Tables 3, 4)

Microhyla “sp. 1” — Poyarkov [Paiarkov] & Vassilieva 2011: Fig. 5.8. Microhyla pineticola — Poyarkov et al. 2014 [partim]

Holotype. Adult male, ZMMU A-7303 (field number NAP-00553, formerly part of ZMMU A-4331 and a member of M. pineticola type series), collected from Da Nhírm River Valley (12.170838° N, 108.697765° E; alt. 1,500 m a.s.l.), Bidoup–Nui Ba National Park, Lam Dong Province, Vietnam by N.A. Poyarkov and A.B. Vassilieva on 26 June 2010.

Paratypes (n=14): Six adult males, the former members of ZMMU A-4331 and members of M. pineticola type series with the following new collection numbers: ZMMU A-7297 (field number NAP-00413), ZMMU A-7298 (field number NAP-00415), ZMMU A-7299 (field number NAP-00416), ZMMU A-7300 (field number NAP-00417), and ZMMU A-7301 (field number NAP-00523), collected from Da Nhírm River Valley (12.180525° N, 108.681983° E; alt. 1,450 m a.s.l.), Bidoup–Nui Ba National Park, Lam Dong Province, Vietnam by N.A. Poyarkov on 5 May 2009; ZMMU A-7302 (field number NAP-00552), collected from Da Nhírm River Valley (12.170838° N, 108.697765° E; alt. 1,500 m a.s.l.), Bidoup–Nui Ba National Park, Lam Dong Province, Vietnam by N.A. Poyarkov and A.B. Vassilieva collected on 26 June 2010. Three adult males, the former members of ZMMU A-5080 with the following new collection numbers: ZMMU A-7304 (field number NAP-01800), and ZMMU A-7305–7306 (field numbers NAP-01884–01885) collected from Giang Ly ranger station (12.185416° N, 108.689419° E; alt. 1,480 m a.s.l.), Bidoup–Nui Ba National Park, Lam Dong Province, Vietnam by N.A. Poyarkov, A.B. Vassilieva and E.A. Galoyan on 07 July 2011. Four adult females, the former members of ZMMU A-4331 with the following new collection numbers: ZMMU A-7307 (field number NAP-09900) collected from the northern slope of Mt. Bidoup (12.116070° N, 108.660232° E; alt. 1,800 m a.s.l.), Bidoup–Nui Ba National Park, Lam Dong Province, Vietnam by N.A. Poyarkov on 9 May 2009; ZMMU A-7308–7309 (field numbers NAP-00418–00419) collected from Da Nhírm River Valley (12.180525° N, 108.681983° E; alt. 1,450 m
a.s.l.), Bidoup–Nui Ba National Park, Lam Dong Province, Vietnam by N.A. Poyarkov on 5 May 2009; and ZMMU A-7310 (field number NAP-01422) collected from Giang Ly ranger station (12.185416° N, 108.689419° E; alt. 1,480 m a.s.l.), Bidoup–Nui Ba National Park, Lam Dong Province, Vietnam by N.A. Poyarkov and A.B. Vassilieva on 26 June 2010.

**Diagnosis:** The new species is allocated to the genus *Microhyla* Tschudi, 1838 based on the following combination of diagnostic characters (Parker 1934; Poyarkov et al. 2014, 2019a, 2020b): small body size; head comparatively narrow; eyes small with circular pupil; spine-like projection of skin at heel and elbow absent; maxillary and vomerine teeth absent; snout less than twice the diameter of the eye; tongue obovate, entire, and free posteriorly; webbing on fingers absent; webbing on toes basal; palmar tubercles distinct; inner and outer metatarsal tubercles prominent; supratympanic fold present; tympanum hidden under the skin.

*Microhyla neglecta* sp. nov. is allocated to the *Microhyla achatina* species group (see Garg et al. 2018; Gorin et al. 2020) and is diagnosed from all other congeners by the following combination of morphological characters: body moderately slender, small, male SVL 17.2–19.5 mm (males), 17.8–23.0 mm (females); dorsum smooth with evenly scattered small flat, tubercles; snout sharply acuminated in lateral profile, nostrils on the lateral sides of snout; finger I longer than one-half the length of finger II; tips of three outer fingers weakly dilated forming weak discs, with median, dorsal, longitudinal grooves; tips of all toes distinctly dilated into discs, with median, dorsal longitudinal grooves; expanded toe discs ca. two times wider than width of penultimate phalanges; metacarpal tubercles two, outer round, inner tubercle oval and prominent; tibiotarsal articulation of a straightened limb reaching well beyond snout; toe webbing basal, formula: I 1½-2½ II 1⅓-3 III 2⅔-3½ IV 3⅔-2½ V; metatarsal tubercles two, prominent, inner elongate, outer round; upper eyelid lacking supraciliary spines or tubercles; a dark line extends along canthus rostralis; dorsal surface of snout light-grey, well-differentiated in colour from the dark-brown interorbital bar, which bears an 8-shaped, dark, medial blotch; a narrow, continuous, black stripe running from the posterior margin of the eye, along the supratympanic fold, transforming into a dark dorsolateral stripe reaching the groin; a distinct, narrow, cream-white stripe extending from the posterior margin of the eye to the axilla; the axillary region and upper lips lack bluish-white speckles; dorsal pattern formed by a weak light-coloured, thin, vertebral stripe; small, dark, middorsal oval marking; a light-brown chevron-shaped marking or “teddy-bear” edged with beige; the lateral sides of dorsum may have indistinct, thin, brownish lines forming nested reverse V-shaped figures; centre of chin grey, sides dark-brown to black, with a thin, light-coloured medial stripe not reaching the chest; belly yellowish with indistinct greyish marbling laterally.

**Description of holotype:** A small-sized, SVL 18.1 mm, adult male specimen in a generally good state of preservation (slightly dehydrated); body habitus moderately slender; head comparatively large, almost as long as wide (HL/HW 1:01); snout truncate in dorsal view, sharply acuminated in lateral profile, slightly protruding beyond lower jaw, longer than eye diameter (EL/SL 0.86); eye rounded, comparatively small, slightly protuberant in dorsal view and not protruding in lateral view, pupil horizontal; dorsal surface of head slightly convex, canthus rostralis sharp; loreal region distinctly concave; nostrils rounded, placed more on the sides of the snout, located closer to the tip of snout than to the eye; tympanum hidden under skin of temporal region; supratympanic fold weak, becoming indistinct above the axilla; maxillary and vomerine teeth absent; vocal sac single, subgular; tongue obovate, entire, and free posteriorly, lacking papillae.

Forelimbs short, ca. one-third of hindlimb length (FLL/HLL 0.34); hand short (HAL/LAL 0.55; HAL/FLL 0.44); fingers comparatively thin, rounded in cross-section, first finger slightly longer than half of second finger length (1FL/2FL 0.53); relative length of fingers: I<IV<II<III. Webbing absent between all fingers; dermal fringes absent; tips of all fingers rounded, tip of finger I not enlarged, tips of fingers II–IV notably widened forming discs, with median, dorsal, longitudinal grooves and dorso-terminal grooves; third finger disc largest; subarticular tubercles on volar surface of fingers barely distinct, flattened, subarticular tubercle formula: 1:1:2:2; nuptial pad absent; two metacarpal (palmar) tubercles, both distinct, inner tubercle round, outer tubercle elongate, slightly larger than inner one (IPTL/OPTL 0.79); area between
Figure 4. (A) dorsal view, (B) ventral view, (C) plantar view of right foot, (D) volar view of left hand, and (E) lateral view of the head of *Microhyla neglecta* sp. nov., holotype, adult male, ZMMU A-7303; and (F) lateral view of the head of *M. pineticola*, holotype, adult female, ZMMU A-5043. Both holotypes are from Bidoop–Nui Ba NP, Lam Dong Province, Vietnam. © Photos Nikolay A. Poyarkov.
Figure 5. *Microhyla neglecta* sp. nov. in life (A1) dorsolateral view, (A2) ventral view of paratype, adult male, ZMMU A-7302; and (B) dorsolateral view of paratype, adult female, ZMMU A-7307. Both paratypes are from Bidoup–Nui Ba NP, Lam Dong Province, Vietnam. © Photos Nikolay A. Poyarkov.
inner and outer palmar tubercles flat and lacking medial or supernumerary palmar tubercles.

Hindlimbs comparatively long, tibia length much longer than half of snout-vent length (TL/SVL 0.61), hindlimb length over 1.5 times longer than snout-vent length (HLL/SVL 1.80); tibiotarsal articulation of adpressed limb reaching well beyond snout (checked prior to preservation); tibia slightly longer than foot (FL/TL 0.98); relative toe lengths: I<II<V<III<IV; tarsal fold on inner surface of tarsus absent; tips of all toes rounded and widened, forming broad, terminal discs; all toe discs having distinct dorso-terminal groves; discs on toes II–V having distinct median, distal, dorso-longitudinal grooves not reaching over one-half of disc length and producing the appearance of two scutes; toes long, thin, slightly flattened in cross-section; toe webbing, formula: 1½-2½ II 1¾-3 III 2¾-3¾ IV 3½-2½ V; toe subarticular tubercles distinct, round, slightly protruding, subarticular tubercle formula: 1:1:2:3:2; two metatarsal tubercles: inner metatarsal tubercle elongate, oval, slightly prominent; outer metatarsal tubercle small, round, shorter than the inner tubercle (OMTL/IMTL 0.74), slightly protruding.

Skin on dorsal surface of head and body smooth with small, flat tubercles irregularly scattered along the medial part of dorsum; supratympanic fold slightly swollen, becoming indistinct posteriorly at level of the axilla; upper eyelid without supraciliary spines or tubercles; lateral head and body smooth, forelimbs dorsally smooth, hindlimbs with few small, flat, dorsal tubercles; ventral surfaces of body and limbs smooth, ventral surfaces of thighs with numerous flat, glandular pustules, cloacal region smooth with few tubercles. Cloacal opening unmodified, directed posteriorly, at the lower level of thighs.

Colouration of holotype. In life, dorsally light-brown, with a distinct slightly darker brownish “teddy-bear”-shaped pattern (sensu Rakotoarison et al. 2017) edged with beige. Anterior parts of head and snout light-grey above, well-differentiated in colour from the darker dorsum. A distinct dark-brown interorbital transverse bar between most medial edges of upper eyelids, extending anterolaterally, covering almost all the posterior two thirds of eyelid; an 8-shaped, medial, dark blotch within the interorbital bar. A weak, thin, light-coloured vertebral stripe runs from the tip of the snout to the vent. A small, elongate, U-shaped, black spot at middorsum. Small tubercles on dorsum edged with brown; two series of three, black sacral spots on each side of body. Dorsolateral surfaces of trunk and upper arm light-brown with indistinct greyish pattern; forelimbs lacking darker dorsal cross-bars, hindlimbs with a single, brown, dorsal cross-bar on proximal part of thighs and middle part of shanks; fingers and toes light-brown above with indistinct, brownish cross-bars. Lateral head brownish, a dark-brown lateral stripe running from tip of snout to nostril, and curving along the edge of the canthus rostralis towards the anterior margin of the eye; upper and lower lips dark-brown with a few light-coloured speckles. A black stripe extends from the posterior margin of the eye along the supratympanic fold to above the axilla along a dorsolateral line reaching the groin and separating the light-brown colouration of dorsum from the dark-brown colour of flanks; the stripe fades ventrally towards the groin. A distinct, narrow, cream-white stripe extends from the posterior margin of the eye to the axilla. Centre of chin grey, sides dark-brown to black with a thin, light-coloured medial stripe not reaching the chest; chest and belly yellowish with indistinct greyish marbling laterally; limbs greyish-pink below with creamy or yellowish irregularly shaped blotches. Iris bronze with dense black dusting at the anterior and posterior edges; pupil horizontal, black, outlined with a golden circle.

In preservative, after ten years of preservation in ethanol, the colours have significantly faded (Fig. 4). The ground colouration of dorsum faded to greyish-brown, black spots and stripes fade to dark-brown, colouration of iris and the yellowish tint of ventral colouration faded completely. However, the overall pattern on dorsum, flanks, and venter remained unchanged.

Variation. Morphometric variation of the type series is presented in Table 3. Paratypes are generally similar to the holotype in body proportions and colouration, with only slight variation is observed in shape of the dorsal pattern. All specimens have a continuous black stripe running from the posterior margin of the eye to the groin. Males (SVL 17.2–19.5 mm, mean 18.3±0.8 mm; n=10) were slightly smaller than females (SVL 17.8–23.0 mm, mean 19.5±2.1 mm; n=5). Colouration also differed little between the sexes. In males, the dorsal pattern is generally represented by indistinct
‘teddy-bear’ or chevron-shaped brownish markings with weak, beige edging (Fig. 5A), while in females, like in ZMMU A-7307 (see Fig. 5B), the lateral body has indistinct, thin, brownish lines forming nested reverse V-shaped figures resembling that of *M. pineticola*. Female ZMMU A-7307 was swollen with yellowish-white eggs with a dark-brown animation pole, ca. 1.1–1.2 mm in diameter (n=10).

**Etymology.** Specific epithet “neglecta” is a Latin adjective in nominative singular, feminine form of “neglectus”, Latin for “having been overlooked”. The name is given in reference to the complicated taxonomic history of the new species, which remained unnoticed until recently and was even included in the type series of its sister species *M. pineticola*. We recommend “Neglected narrow-mouth frog” as the common English name, “Незамеченный Узкорот” as the name in Russian, and “Nhái bâu quên lãng” in Vietnamese.

**Comparison.** The differences of the new species from all other congeners are summarized in Table 4. In general morphology, *Microhyla neglecta* sp. nov. superficially most resembles its sister species *M. pineticola* s. str., however the new species can be readily distinguished from the latter by having the following suite of morphological characters: (1) a moderately slender body (Fig. 4A) (vs stocky, triangular, see Figs. 3A,C); (2) a thick continuous black stripe running from the posterior edge of eye to the groin (see Fig. 4E, Fig. 5A1) (vs thin and interrupts above the axilla, see Fig. 3G, Fig. 4F); (3) a yellowish belly with indistinct greyish marbling laterally (see Fig. 4B, Fig. 5A2) (vs purplish-grey with indistinct whitish mottingling, Fig. 3B,D); (4) medially grey throat laterally dark brown to black, with a thin white medial line running from chin up to the posterior edge of throat (Fig. 4B, Fig. 5A2) (vs dark-greyish laterally orange speckles, with a thin light-colour medial line running from chin up to the chest and belly, and also connects to the two white lines continuing to the ventral surface of forelimbs, see Fig. 3D); (5) a distinct thin cream-white stripe from posterior eye to axilla and uniform lips and axilla (Fig. 4E) (vs an indistinct beige stripe, and the upper lips and axilla with numerous bluish-white speckles, see Fig. 3G, Fig. 4F); (6) first finger longer than one half of the second finger (vs shorter); (7) an oval shaped, elongated outer metacarpal tubercle (vs rounded); (8) comparatively longer hindlimbs, with a tibiotarsal articulation of straightened limb projecting well beyond snout (vs shorter than snout); (9) slightly less developed foot webbing *I* 1½-2½ *II* 1¾-3 *III* 2¾-3¼ *IV* 3¾-2½ *V* (vs *I* 1½-2½ *II* 1¾-3 *III* 2½-3¼ *IV* 4-2½ *V*); and (10) sharply acuminate snout in lateral profile (vs rounded).

Based on morphological characteristics and the phylogenetic position, *Microhyla neglecta* sp. nov. can be assigned to the *M. achatina* species group, and its comparison to other members of this group are the most pertinent; we present it below. The new species differs from (1) *M. achatina* by having a smaller body SVL 17.2–19.5 mm in males and 17.8–23.0 mm in females (vs 19.7–23.0 mm in males and 24.0–26.1 mm in females), first finger longer than one half of the second finger (vs shorter), a black spot on the middorsum (vs absent), a comparatively less developed foot webbing *I* 1½-2½ *II* 1¾-3 *III* 2¾-3¼ *IV* 3¾-2½ *V* (vs *I* 2½-3¼ *II* 2–3¾ *III* 3-4 *IV* 4-3 *V*), and a continuous dark line above the axilla (vs interrupted); (2) from *M. borneensis* by having a larger body SVL 17.2–19.5 mm in males and 17.8–23.0 mm in females (vs 11.0–13.0 mm in males and 18.0–19.0 mm in females), a well-developed first finger (vs greatly reduced to a nub), a light vertebral line (vs absent), tibiotarsal articulation reaching well beyond snout (vs not reaching the snout); (3) from *M. fodiens* by having a moderately slender body habitus (vs stout), snout acuminate in lateral profile (vs rounded), first finger longer than one half of the second finger (vs shorter), longitudinal grooves on the dorsal surface of fingers and toes (vs absent), a light vertebral line (vs absent), and tibiotarsal articulation reaching well beyond snout (vs not reaching the eye); (4) from *M. gadjahmadai* by having a moderately slender habitus (vs stout), snout acuminate in lateral profile (vs rounded), a strong continuous dark stripe above the axilla (vs thin and interrupted), and a comparatively less developed foot webbing *I* 1½-2½ *II* 1¾-3 *III* 2¼-3½ *IV* 3¾-2½ *V* (vs *I* 2½-3¼ *II* 1¾-3 *III* 3-4 *IV* 4-2½ *V*); (5) from *M. heymonsi* by having two lower metacarpal tubercles and no supernumerary tubercles on palm (vs three distinct prominent metacarpal tubercles and supernumerary tubercles), snout acuminate in lateral profile (vs obtusely pointed), tibiotarsal articulation reaching well beyond snout (vs not reaching the snout), and a comparatively less developed foot webbing *I* 1½-2½ *II* 1¾-3 *III* 2¼-3³/₄ *IV* 3¼-2½ *V* (vs *I* 2-2½ *II* 2-3 *III* 3-4 *IV* 4½-3 *V*); (6) from *M. irrawaddy* by having
a larger body SVL 17.2–19.5 mm in males (vs 12.3–17.1 mm), a smooth dorsum with few small tubercles (vs granular), longitudinal grooves on the dorsal surface of fingers and toes (vs absent), supratympanic fold distinctly edged with black (vs absent), tibiotarsal articulation reaching well beyond snout (vs not reaching the snout), and a comparatively less developed foot webbing I 11/2–21/2 II 13/4–3 II 23/4–31/4 IV 31/4–21/2 V (vs 12–3 II 2–3 III 3–41/2 IV 41/2–21/2 V); (7) from M. kodial by having snout acuminate in lateral profile (vs rounded), canthus rostralis distinct (vs indistinct), a vertebral line (vs absent), and a lateral dark stripe from eye to groin (vs absent); (8) from M. malang by having snout acuminate in lateral profile (vs rounded), first finger longer than one half of the second finger (vs shorter), a dark continuous line above the axilla (vs interrupted), a light-colour vertebral line (vs absent), and a comparatively less developed foot webbing I 11/2–21/2 II 13/4–3 III 23/4–31/4 IV 31/4–21/2 V (vs 11/2–2 11–2 1–21/2 III 13/2–3 IV 31/2–1 V); (9) from M. mantheyi by having first finger longer than one half of the second finger (vs shorter), a smooth dorsum with few small tubercles (vs granular with regularly scattered pustules), a dark continuous line above the axilla (vs interrupted); (10) from M. minuta by having a larger body SVL 17.2–19.5 mm in males and 17.8–23.0 mm in females (vs 14.7–15.9 mm in males and 15.7–17.2 mm in females), smooth dorsum with few small tubercles (vs granular with regularly scattered pustules), a dark dorsolateral stripe (vs absent), a light-colour vertebral line (vs absent), and tibiotarsal articulation reaching well beyond snout (vs not reaching the snout); (11) from M. orientalis by having a larger body SVL 17.2–19.5 mm in males and 17.8–23.0 mm in females (vs 15.8–17.4 mm in males and 15.8–17.4 mm in females), first finger longer than one half of the second finger (vs shorter), tibiotarsal articulation reaching well beyond snout (vs not reaching reaching the snout), and a distinct light vertebral line (vs faint).

**Distribution.** To date, the new species is known exclusively from three localities within the eastern portion of the Bidoup–Nui Ba National Park in Lam Dong Province, southern Vietnam. *Microhyla neglecta* was observed at elevations from 1,450 m a.s.l. (in the environs of the Giang Ly ranger station) to 1,800 m a.s.l. (on the northern slope of Mt. Bidoup). All three known localities are located within a narrow area (approximately 20 km²) within the Da Nhim River Valley.

**Natural history.** All the *Microhyla neglecta* specimens were found on the ground (both during day and night) in mixed montane tropical forests with a predominance of *Lithocarpus* sp., *Castanopsis* sp., and *Quercus* sp. (Family Fagaceae), *Pinus krempfii* (Family Pinaceae), and with a dense understory comprised of *Pandanus* sp. (Family Pandanaceae) and various bushes and small trees.

In all localities surveyed, *M. neglecta* was recorded in sympathy with *M. pineticola*, though the specimens of the new species were usually found within mixed montane forest, while *M. pineticola* specimens were often recorded in open areas and dry monodominant pine forests comprised of *Pinus kesiya*. Other syntopic amphibian species were *M. annamensis* Smith, 1923; *M. berdmorei* (Blyth, 1856); *M. pulchella* Poyarkov, Vassilieva, Orlov et al., 2014; *Ingerophrynus galeatus* (Günther, 1864); *Feithyla palpebralis* (Smith, 1924); *Rhacophorus calcaneus* Smith, 1924; *R. vampyrus* Rowley, Le, Tran et al. 2010; and *Polypedates megacephalus* Hallowell, 1861.

The reproduction of the new species is insufficiently studied due to the earlier confusion with the sympatric and superficially similar species *M. pineticola*. Further morphological and genetic studies are required to clarify the differences in larval morphology between these two species.

**Conservation status.** To date, *Microhyla neglecta* is known only from a narrow area within Bidoup–Nui Ba National Park (Lam Dong Province), Langbian Plateau, southern Vietnam. Our intensive surveys in several other forested areas on the Langbian Plateau within Lam Dong, Khanh Hoa, and Dak Lak Provinces failed to discover new populations of *M. neglecta*. Thus the actual extent of distribution of the new species and its population trends remain unknown.

The application of the IUCN Red List criteria (2019: version 14) shows that *Microhyla neglecta* is restricted to an extent of occurrence (EOO) of 70–100 km² where 15 individuals were recorded within 10 km distance. Given the relatively narrow distribution range and the rapid montane forest fragmentation accelerated by the high human population density within the range, we suggest *M. neglecta* to be considered a Near Threatened (NT) species.
### Table 3. Measurements of the type series of *Microhyla piniticola* and *M. neglecta* sp. nov.; H, holotype; Continue on next page.

| Cat. No     | SL | EL | N-EL | HL | HW | IND | IOD | UEW | FLL | LAL |
|------------|----|----|------|----|----|-----|-----|-----|-----|-----|
| *Microhyla piniticola* s. str.          |    |    |      |    |    |     |     |     |     |     |
| males      |    |    |      |    |    |     |     |     |     |     |
| 1. ZMMU-A5080 | 17.5 | 6.3 | 2.3 | 2.2 | 1.5 | 5.5 | 1.6 | 2.5 | 1.2 | 10.0 | 8.1 |
| 2. ZMMU-A6029 | 17.4 | 6.4 | 2.4 | 2.5 | 1.4 | 6.6 | 1.8 | 2.4 | 1.4 | 9.9  | 7.3 |
| 3. ZMMU-A4331 | 18.6 | 6.0 | 2.2 | 2.0 | 1.6 | 6.5 | 1.7 | 2.1 | 1.1 | 11.6 | 7.9 |
| Mean±SD    | 17.9±0.7 | 6.2±0.2 | 2.3±0.1 | 2.3±0.2 | 1.5±0.1 | 6.2±0.6 | 1.7±0.1 | 2.3±0.2 | 1.2±0.1 | 10.5±1.0 | 7.8±0.4 |
| Range      | 17.4–18.6 | 6.0–6.4 | 2.2–2.4 | 2.0–2.5 | 1.4–1.6 | 5.5–6.6 | 1.6–1.8 | 2.1–2.5 | 1.1–1.4 | 9.9–11.6 | 7.3–8.1 |
| females    |    |    |      |    |    |     |     |     |     |     |     |
| 4. ZMMU-A4331 | 20.0 | 6.5 | 2.7 | 2.3 | 1.2 | 7.1 | 1.8 | 2.5 | 1.3 | 10.8 | 9.3 |
| 5. ZMMU-A5043H | 22.3 | 7.3 | 2.8 | 2.4 | 1.8 | 7.0 | 2.2 | 2.5 | 1.6 | 12.1 | 8.7 |
| 6. ZMMU-A7296 | 22.0 | 6.9 | 2.8 | 2.5 | 1.6 | 7.3 | 2.1 | 2.4 | 2.2 | 11.5 | 9.2 |
| Mean±SD    | 21.4±1.2 | 6.9±0.4 | 2.8±0.1 | 2.4±0.1 | 1.5±0.3 | 7.1±0.1 | 2.0±0.2 | 2.5±0.1 | 1.7±0.5 | 11.5±0.7 | 9.1±0.3 |
| Range      | 20.0–22.3 | 6.5–7.3 | 2.7–2.8 | 2.3–2.5 | 1.2–1.8 | 7.0–7.3 | 1.8–2.2 | 2.4–2.5 | 1.3–2.2 | 10.8–12.1 | 8.7–9.3 |
| *Microhyla neglecta* sp. nov.          |    |    |      |    |    |     |     |     |     |     |     |
| males      |    |    |      |    |    |     |     |     |     |     |     |
| 1. ZMMU-A7297 | 18.7 | 5.5 | 2.5 | 2.0 | 1.6 | 6.3 | 1.9 | 2.5 | 1.2 | 12.1 | 7.9 |
| 2. ZMMU-A7298 | 19.0 | 6.2 | 2.8 | 2.2 | 1.5 | 6.5 | 1.9 | 2.2 | 1.0 | 10.9 | 8.1 |
| 3. ZMMU-A7299 | 19.5 | 6.6 | 2.7 | 2.3 | 1.6 | 6.2 | 1.9 | 2.3 | 1.1 | 11.1 | 8.5 |
| 4. ZMMU-A7300 | 17.9 | 3.6 | 2.3 | 2.0 | 1.3 | 6.4 | 1.4 | 2.2 | 1.2 | 11.5 | 8.8 |
| 5. ZMMU-A7301 | 18.0 | 6.5 | 2.3 | 2.1 | 1.6 | 6.2 | 1.9 | 2.5 | 1.3 | 10.7 | 8.4 |
| 6. ZMMU-A7302 | 19.2 | 6.1 | 2.5 | 1.9 | 1.7 | 5.8 | 1.8 | 2.3 | 1.1 | 11.0 | 8.2 |
| 7. ZMMU-A7303H | 18.1 | 6.1 | 2.5 | 2.1 | 1.7 | 6.0 | 1.8 | 2.3 | 1.0 | 11.0 | 8.0 |
| 8. ZMMU-A7304 | 17.2 | 5.9 | 2.5 | 2.2 | 1.3 | 5.9 | 2.0 | 2.8 | 1.3 | 10.6 | 7.5 |
| 9. ZMMU-A7305 | 18.2 | 5.6 | 2.5 | 2.3 | 1.5 | 6.5 | 1.7 | 2.5 | 1.3 | 10.5 | 7.6 |
| 10. ZMMU-A7306 | 17.4 | 5.2 | 2.5 | 1.8 | 1.3 | 6.4 | 1.7 | 2.1 | 1.2 | 9.5  | 7.4 |
| Mean±SD    | 18.3±0.8 | 5.9±0.4 | 2.5±0.2 | 2.1±0.2 | 1.5±0.2 | 6.2±0.2 | 1.9±0.1 | 2.4±0.2 | 1.2±0.1 | 10.9±0.7 | 8.0±0.4 |
| Range      | 17.2–19.5 | 5.2–6.6 | 2.3–2.8 | 1.8–2.3 | 1.3–1.7 | 5.8–6.5 | 1.7–2.0 | 2.1–2.8 | 1.0–1.3 | 9.5–12.1 | 7.4–8.8 |
| females    |    |    |      |    |    |     |     |     |     |     |     |
| 11. ZMMU-A7307 | 23.0 | 6.9 | 3.0 | 2.4 | 1.8 | 7.2 | 2.1 | 2.6 | 1.3 | 11.1 | 9.9 |
| 12. ZMMU-A7308 | 18.7 | 6.1 | 2.7 | 2.5 | 1.2 | 6.3 | 1.9 | 2.4 | 1.2 | 10.6 | 8.0 |
| 13. ZMMU-A7309 | 19.7 | 6.4 | 3.1 | 2.3 | 2.1 | 7.1 | 1.9 | 2.4 | 1.0 | 11.9 | 8.9 |
| 14. ZMMU-A7310 | 18.0 | 6.7 | 2.5 | 2.2 | 1.8 | 6.9 | 1.8 | 2.8 | 1.3 | 11.5 | 8.2 |
| 15. ZMMU-A7311 | 17.8 | 5.8 | 2.2 | 2.0 | 1.6 | 5.6 | 1.7 | 2.8 | 1.1 | 10.5 | 7.6 |
| Mean±SD    | 19.5±2.1 | 6.4±0.4 | 2.7±0.4 | 2.3±0.2 | 1.7±0.3 | 6.6±0.7 | 1.9±0.1 | 2.6±0.2 | 1.2±0.1 | 11.1±0.6 | 8.5±0.9 |
| Range      | 17.8–23.0 | 5.8–6.9 | 2.2–3.1 | 2.0–2.5 | 1.2–2.1 | 5.6–7.2 | 1.7–2.1 | 2.4–2.8 | 1.0–1.3 | 10.5–11.9 | 7.6–9.9 |
### Table 3 continued. Measurements of the type series of *Microhyla pineticola* and *M. neglecta* sp. nov.; H, holotype; Continue on next page.

| Microhyla pineticola s. str. | HAL | IFL | IPTL | OPTL | 3FDD | HLL | TL | FL | IMTL | ITOEL | OMTL | 4TDD |
|-----------------------------|-----|-----|------|------|------|-----|----|----|------|-------|------|------|
| males                       |     |     |      |      |      |     |    |    |      |       |      |      |
| 1. ZMMU-A5080               | 4.5 | 0.9 | 0.6  | 0.6  | 0.9  | 30.0| 10.1| 10.3| 0.7  | 1.9   | 0.5  | 0.7  |
| 2. ZMMU-A6029               | 4.4 | 0.9 | 0.6  | 0.8  | 0.6  | 30.8| 11.1| 10.4| 0.7  | 1.7   | 0.5  | 0.8  |
| 3. ZMMU-A4331               | 4.2 | 1.0 | 0.7  | 0.5  | 0.5  | 31.0| 12.0| 10.5| 0.7  | 1.4   | 0.5  | 0.9  |
| Mean±SD 4.4±0.1             |     |     |      |      |      |     |    |    |      |       |      |      |
| Range 4.2–4.5               |     |     |      |      |      |     |    |    |      |       |      |      |
| females                     |     |     |      |      |      |     |    |    |      |       |      |      |
| 4. ZMMU-A4331               | 5.2 | 1.0 | 0.6  | 0.6  | 0.9  | 34.5| 12.2| 12.8| 0.8  | 2.1   | 0.6  | 0.9  |
| 5. ZMMU-A5043H              | 5.4 | 1.3 | 0.9  | 1.0  | 0.7  | 35.6| 12.7| 12.9| 0.9  | 2.2   | 0.8  | 1.1  |
| 6. ZMMU-A7296               | 5.5 | 1.2 | 0.9  | 0.7  | 0.7  | 36.3| 13.3| 12.1| 1.0  | 0.6   | 0.5  | 1.0  |
| Mean±SD 5.4±0.1             |     |     |      |      |      |     |    |    |      |       |      |      |
| Range 5.2–5.5               |     |     |      |      |      |     |    |    |      |       |      |      |

| Microhyla neglecta sp. nov. | HAL | IFL | IPTL | OPTL | 3FDD | HLL | TL | FL | IMTL | ITOEL | OMTL | 4TDD |
|-----------------------------|-----|-----|------|------|------|-----|----|----|------|-------|------|------|
| males                       |     |     |      |      |      |     |    |    |      |       |      |      |
| 1. ZMMU-A7297               | 5.0 | 1.2 | 0.5  | 0.7  | 0.4  | 33.6| 11.1| 11.3| 0.7  | 1.7   | 0.5  | 0.8  |
| 2. ZMMU-A7298               | 4.5 | 1.1 | 0.6  | 0.9  | 0.4  | 32.6| 11.2| 11.7| 1.0  | 1.8   | 0.6  | 0.8  |
| 3. ZMMU-A7299               | 4.9 | 1.1 | 0.6  | 1.0  | 0.5  | 35.4| 11.7| 11.4| 0.8  | 2.0   | 0.5  | 0.8  |
| 4. ZMMU-A7300               | 4.8 | 1.2 | 0.7  | 0.8  | 0.5  | 34.8| 11.5| 11.7| 0.9  | 1.9   | 0.7  | 0.7  |
| 5. ZMMU-A7301               | 5.0 | 1.0 | 0.7  | 1.0  | 0.6  | 32.6| 11.1| 11.6| 0.7  | 1.8   | 0.5  | 0.7  |
| 6. ZMMU-A7302               | 4.7 | 1.3 | 0.8  | 1.0  | 0.4  | 34.0| 11.2| 11.5| 0.7  | 1.8   | 0.4  | 0.8  |
| 7. ZMMU-A7303H              | 4.4 | 1.0 | 0.6  | 0.8  | 0.4  | 32.6| 11.0| 10.8| 0.6  | 1.7   | 0.5  | 0.7  |
| 8. ZMMU-A7304               | 4.3 | 0.9 | 0.7  | 0.9  | 0.4  | 32.2| 11.4| 10.6| 0.7  | 1.7   | 0.6  | 0.8  |
| 9. ZMMU-A7305               | 4.6 | 1.1 | 0.6  | 0.7  | 0.5  | 32.1| 11.2| 11.3| 0.9  | 1.8   | 0.7  | 0.9  |
| 10. ZMMU-A7306              | 4.2 | 0.9 | 0.5  | 0.8  | 0.4  | 32.0| 11.1| 10.2| 0.7  | 1.3   | 0.4  | 0.8  |
| Mean±SD 4.6±0.3             |     |     |      |      |      |     |    |    |      |       |      |      |
| Range 4.2–5.0               |     |     |      |      |      |     |    |    |      |       |      |      |
| females                     |     |     |      |      |      |     |    |    |      |       |      |      |
| 11. ZMMU-A7307              | 5.3 | 1.3 | 0.8  | 0.9  | 0.6  | 37.6| 14.4| 13.6| 0.8  | 2.4   | 0.6  | 1.2  |
| 12. ZMMU-A7308              | 4.9 | 1.2 | 0.9  | 1.0  | 0.5  | 37.5| 11.6| 11.3| 0.7  | 1.6   | 0.5  | 1.1  |
| 13. ZMMU-A7309              | 5.0 | 1.4 | 0.6  | 0.9  | 0.5  | 36.5| 13.4| 11.8| 0.7  | 1.8   | 0.6  | 0.7  |
| 14. ZMMU-A7310              | 4.8 | 1.2 | 0.8  | 1.0  | 0.4  | 34.2| 11.5| 12.1| 0.8  | 2.0   | 0.4  | 0.9  |
| 15. ZMMU-A7311              | 4.5 | 1.2 | 0.6  | 0.8  | 0.5  | 31.4| 10.7| 10.2| 0.8  | 1.7   | 0.8  | 0.8  |
| Mean±SD 4.9±0.3             |     |     |      |      |      |     |    |    |      |       |      |      |
| Range 4.5–5.3               |     |     |      |      |      |     |    |    |      |       |      |      |
Table 4. Morphological comparison between Microhyla neglecta sp. nov with 52 currently recognized species of genus Microhyla. Members of the M. achatina species group are highlighted; ? = no data.

| Species                  | SVL (males) | SVL (females) | Body habit         | Snout in lateral profile |
|--------------------------|-------------|---------------|---------------------|--------------------------|
| M. neglecta sp. nov.     | 17.2–19.5   | 17.8–23.0     | Moderately slender  | Acuminate                |
| M. achatina              | 21.7–24.3   | 20.6–28.0     | Slender             | Obtusely pointed         |
| M. annamensis            | 15.2–19.8   | 18.2–22.6     | Moderately stocky   | Bluntly rounded          |
| M. annectens             | 14.4–15.6   | 18.2–18.4     | Slender             | Rounded                  |
| M. arboricola            | 13.2–15.0   | 15.9–17.0     | Moderately slender  | Pointed                  |
| M. aurantiventris        | 25.2–27.0   | 30.5          | Moderately stocky   | Rounded                  |
| M. beilunensis           | 19.1–23.7   | 26.4–28.3     | Moderately slender  | Bluntly rounded          |
| M. berdmorei             | 23.8–32.5   | 26.2–45.6     | Slender             | Obtusely pointed         |
| M. boreensis             | 11–13       | 18–19         | Stocky              | Obtusely pointed         |
| M. butleri               | 20.0–25.0   | 21.0–26.0     | Slender             | Rounded                  |
| M. chakrpanii            | 22          | ?             | Moderately stout    | Obtusely rounded         |
| M. darevskii             | 27.0–32.6   | ?             | Stocky, flattened   | Rounded                  |
| M. darreli               | 15.0–15.7   | ?             | Rather slender      | Sub ovoid                |
| M. eos                   | 21.5        | 26.9–27.8     | Stout               | Rounded                  |
| M. fanjingshanensis      | 19.0–22.7   | 22.5–23.0     | Slender             | Rounded                  |
| M. fissipes              | 18.0–27.5   | 20.0–28.0     | Moderately slender  | Rounded                  |
| M. fodiens               | 20.1–29.1   | 20.0–30.0     | Stout               | Rounded                  |
| M. gadjahmadai           | 18.2–21.3   | 20.4–25.5     | Stout               | Rounded                  |
| M. heymons               | 16.5–22.0   | 18.0–26.5     | Stocky              | Obtusely pointed         |
| M. hongxiaoensis         | 13.6–14.7   | 18.3–18.6     | Slender             | Bluntly rounded          |
| M. irrawaddy             | 12.3–17.1   | 16.7–20.9     | Very slender        | Acuminate                |
| M. karunaramaei          | 15.8–19.1   | 19.6–21.0     | Moderately stocky   | Rounded                  |
| M. kodial                | 16.9–17.4   | 18.0–20.4     | Slender             | Rounded                  |
| M. kurokoino             | 23.8–27.8   | 28.8–34.6     | Moderately slender  | Rounded                  |
| M. laterite              | 15.3–16.6   | 18.4          | Very small sized    | Obtuse                   |
| M. maculifera            | 12.0–13.3   | 11.8          | Moderately stout    | Bluntly rounded          |
| M. malang                | 18.7–22.2   | 19.0–23.4     | Stocky              | Rounded                  |
| M. mantheyi              | 15.0–29.2   | 14.8–24.1     | Stocky              | Pointed                  |
| M. marmorata             | 18.8–21.5   | 21.1–23.2     | Moderately stocky   | Bluntly rounded          |
| M. mitintalei            | 21.7–27.3   | 24.4          | Slender             | Sub-ovoid                |
| M. minuta                | 14.7–15.9   | 15.7–17.2     | Slender             | Bluntly rounded          |
| M. mixtura               | 18.8–25.2   | 24.8–26.2     | Stout               | Rounded                  |
| M. mukhlesuri            | 16.5–21.0   | 17.3–18.4     | Moderately slender  | Rounded                  |
| M. mymsinghensis         | 14.2–17.6   | 15.2–21.3     | Stocky              | Truncated                |
| M. nanopollela           | 13.5        | 16.6          | Slender             | Rounded                  |
| M. nepenthicola          | 10.6–12.8   | 17.9–18.8     | Stocky              | Obtusely pointed         |
| M. nilphamariensis       | 14.8–20.0   | 18.7–21.0     | Stout               | Rounded                  |
| M. okinavensis           | 20.8–25.6   | 26.5–30.8     | Moderately slender  | Rounded                  |
| M. orientalis            | 15.8–17.4   | 15.8–17.4     | Moderately slender  | Rounded                  |
| M. ornata                | 13.4–24.9   | 24.9–26.2     | Moderately slender  | Rounded                  |
| M. palmipes              | 16          | 21.8          | Slender             | Rounded                  |
| M. perpava               | 10.5–11.9   | 12.4–14.5     | Moderate            | Obtusely pointed         |
| M. petrigena             | 13.9–16.2   | 15.1–17.8     | Moderately stout    | Obtusely pointed         |
| M. picta                 | 25.2–30.1   | 27.2–33.4     | Stout               | Rounded                  |
| M. pinetico s. str.      | 17.4–18.6   | 20.0–22.3     | Stocky              | Rounded                  |
| M. pulchella             | 14.7–21.6   | 18.1–25.8     | Moderately stocky   | Bluntly rounded          |
| M. pulchra               | 23.0–32.0   | 28.0–36.5     | Stocky              | Obtusely pointed         |
| M. rubra                 | 20.0–27.5   | 20.5–29.5     | Stout               | Rounded                  |
| M. sholigari             | 15.9–16.2   | 15.9–19.2     | Moderately slender  | Truncated                |
| M. superciarius          | 12.7        | 12            | Slender             | Rounded                  |
| M. taraensis             | 19.9–20.9   | 22.1–24.9     | Stout               | Rounded                  |
| M. tetix                 | 10.1–13.7   | 15.2–17.6     | Slender             | Rounded                  |
| M. zeylanica             | 14.4–18.3   | 15.8–20.0     | Moderately slender  | Rounded                  |
Table 4 continued. Morphological comparison between *Microhyla neglecta* sp. nov with 52 currently recognized species of genus *Microhyla*. Members of the *M. achatina* species group are highlighted; ? = no data.

| Species                        | Skin on dorsum                  | F1 vs F2 | Disks on distal end of fingers |
|--------------------------------|---------------------------------|----------|--------------------------------|
| *M. neglecta* sp. nov.         | Smooth with few tubercles       | F1 > ½F2 | present                        |
| *M. achatina*                  | Smooth or feebly tubercular     | F1 < ½F2 | present                        |
| *M. annamensis*                | Warty, strongly tubercular      | F1 < ½F2 | present                        |
| *M. annectens*                 | Smooth                          | F1 < ½F2 | present                        |
| *M. arboricola*                | Feebly granular                 | F1 < ½F2 | present                        |
| *M. aurantiventris*            | Shagreened, tiny tubercles      | F1 > ½F2 | present                        |
| *M. beilunensis*               | Smooth, small tubercles         | F1 < ½F2 | present (weak)                 |
| *M. berdmorei*                 | Smooth, small tubercles         | F1 < ½F2 | present (weak)                 |
| *M. borneensis*                | Smooth, small tubercles         | nub / bulge | weak / absent                |
| *M. butleri*                   | Smooth or tubercular            | F1 > ½F2 | present (weak)                 |
| *M. chakrapanii*               | Smooth                          | F1 > ½F2 | absent                         |
| *M. darevskii*                 | Slightly tubercular or pustulate| F1 > ½F2 | absent                         |
| *M. darreli*                   | Shagreened to sparsely granular | F1 > ½F2 | present (weak)                 |
| *M. eos*                       | Smooth to shagreened            | ?         | present                        |
| *M. fanjingshanensis*          | Roughish with tiny tubercles    | F1 > ½F2 | absent                         |
| *M. fissipes*                  | Smooth or slightly tubercular   | F1 > ½F2 | absent                         |
| *M. fodiens*                   | Feebly tubercular               | F1 < ½F2 | absent                         |
| *M. gadjahmadai*               | Low tubercles                   | F1 > ½F2 | present (weak)                 |
| *M. heymonsi*                  | Smooth                          | F1 ≤ ½F2 | present                        |
| *M. hongiaoensis*              | Low tubercles                   | F1 < ½F2 | present                        |
| *M. irrawaddy*                 | Granular                        | F1 > ½F2 | present                        |
| *M. karunaraezi*               | Smooth                          | F1 > ½F2 | present                        |
| *M. kodial*                    | Tuberculated                    | F1 > ½F2 | present                        |
| *M. karamotoi*                 | Smooth or slightly tubercular   | F1 ≤ ½F2 | absent                         |
| *M. laterite*                  | Smooth                          | F1 > ½F2 | present                        |
| *M. maculifera*                | Tuberculated                    | F1 > ½F2 | absent                         |
| *M. malang*                    | Smooth                          | F1 < ½F2 | present                        |
| *M. mantheyi*                  | Granular, feebly pustular       | F1 < ½F2 | present                        |
| *M. marmorata*                 | Smooth or feebly pustular       | F1 < ½F2 | present                        |
| *M. mhibntalei*                | Smooth                          | F1 ≤ ½F2 | absent                         |
| *M. minuta*                    | Granular, feebly pustular       | F1 ≤ ½F2 | present                        |
| *M. mixtura*                   | Smooth, with tubercles          | F1 < ½F2 | present (weak)                 |
| *M. mukkesari*                 | Smooth                          | F1 > ½F2 | absent                         |
| *M. mymensinghensis*           | Smooth                          | F1 > ½F2 | absent                         |
| *M. nanoploxxa*                | Smooth                          | nub / bulge | present                |
| *M. nepenthicola*              | Smooth, small tubercles         | nub / bulge | weak / absent                |
| *M. nilphamariensis*           | Smooth                          | F1 > ½F2 | absent                         |
| *M. okinawensis*               | Smooth                          | F1 ≤ ½F2 | present                        |
| *M. orientalis*                | Smooth or slightly tubercular   | F1 < ½F2 | weak                           |
| *M. ornata*                    | Smooth or slightly tubercular   | F1 ≤ ½F2 | absent                         |
| *M. palmipes*                  | Smooth or slightly tubercular   | nub / bulge | present                |
| *M. perparva*                  | Smooth                          | nub / bulge | present                |
| *M. petrigena*                 | Smooth, tubercles posteriorly   | nub / bulge | present                |
| *M. picta*                     | Smooth or slightly warty        | F1 ≤ ½F2 | absent                         |
| *M. pineticola s. str.*        | Feebly granular                 | F1 ≤ ½F2 | present                        |
| *M. pulchella*                 | Smooth                          | F1 < ½F2 | present                        |
| *M. pulchra*                   | Smooth, feebly granular         | F1 < ½F2 | absent                         |
| *M. rubra*                     | Smooth, feebly tuberculated     | F1 ≤ ½F2 | absent                         |
| *M. sholigari*                 | Smooth                          | F1 > ½F2 | present                        |
| *M. superciariis*              | Smooth                          | F1 < ½F2 | present                        |
| *M. taraiensis*                | Granular                        | F1 > ½F2 | absent                         |
| *M. tetrix*                    | Smooth                          | F1 = ½F2 | present                        |
| *M. zeylanica*                 | Smooth or slightly tubercular   | F1 > ½F2 | absent                         |
Table 4 continued. Morphological comparison between *Microhyla neglecta* sp. nov with 52 currently recognized species of genus *Microhyla*. Members of the *M. achatina* species group are highlighted; ? = no data.

| Species                        | Median longitudinal grooves on dorsal finger disks | Disks at the distal end of toes | Dorsal peripheral grooves on toe disks | Metatarsal tubercles | Supercrelary tubercles |
|--------------------------------|---------------------------------------------------|---------------------------------|----------------------------------------|----------------------|------------------------|
| *M. neglecta* sp. nov.         | present                                           | present                         | present (weak)                         | 2                    | absent                 |
| *M. achatina*                  | present                                           | present                         | present                                | 2                    | absent                 |
| *M. annamensis*                | present                                           | present                         | present                                | 2                    | absent                 |
| *M. annectens*                 | present                                           | present                         | present                                | 1                    | absent                 |
| *M. arboricola*                | present (weak)                                    | present                         | present                                | 1                    | absent                 |
| *M. aurantiventris*            | present (weak)                                    | present                         | present                                | 2                    | absent                 |
| *M. belunensis*                | absent                                            | present                         | present                                | 2                    | absent                 |
| *M. bermorei*                  | present                                           | present                         | present                                | 2                    | absent                 |
| *M. borneensis*                | present                                           | present                         | present                                | 2                    | absent                 |
| *M. butleri*                   | present                                           | present                         | present                                | 2                    | absent                 |
| *M. chakrapanii*               | absent                                            | present                         | absent                                 | 2                    | absent                 |
| *M. darevskii*                 | present                                           | weak                            | present                                | 2                    | absent                 |
| *M. darrei*                    | absent                                            | present (weak)                  | present                                | 2                    | absent                 |
| *M. eos*                       | absent                                            | present                         | present                                | 2                    | absent                 |
| *M. fanjiangshanensis*         | absent                                            | present                         | present                                | 2                    | absent                 |
| *M. fissipes*                  | absent                                            | absent                          | absent                                 | 2                    | absent                 |
| *M. fodiens*                   | absent                                            | absent                          | absent                                 | 2                    | absent                 |
| *M. gadjahmadai*               | present                                           | present                         | present                                | 2                    | absent                 |
| *M. heymonsi*                  | present                                           | present                         | present                                | 2                    | absent                 |
| *M. hongkaoensis*              | absent                                            | present                         | present (weak)                         | 2                    | absent                 |
| *M. irrawaddy*                 | absent                                            | present (weak)                  | present                                | ?                    | absent                 |
| *M. karunaramei*               | present                                           | present                         | present                                | 2                    | absent                 |
| *M. kodial*                    | absent                                            | present                         | absent                                 | 2                    | absent                 |
| *M. kuramotoi*                 | absent                                            | present                         | absent                                 | 2                    | absent                 |
| *M. laterite*                  | present                                           | present                         | present                                | 2                    | present               |
| *M. maculifera*                | absent                                            | present (weak)                  | absent                                 | 1                    | absent                 |
| *M. malang*                    | present                                           | present                         | present                                | 2                    | absent                 |
| *M. manthysi*                  | present                                           | present                         | present                                | 2                    | absent                 |
| *M. marmorata*                 | present                                           | present                         | present                                | 2                    | absent                 |
| *M. mihintalei*                | absent                                            | absent                          | absent                                 | 2                    | present               |
| *M. minuta*                    | present (weak)                                    | present                         | present                                | 2                    | absent                 |
| *M. mixtura*                   | absent                                            | present                         | present                                | 2                    | absent                 |
| *M. mukhlesuri*                | absent                                            | present                         | absent                                 | 2                    | absent                 |
| *M. mymensinghensis*           | absent                                            | present                         | absent                                 | 2                    | absent                 |
| *M. nanopollexa*               | present                                           | present                         | present                                | 1                    | absent                 |
| *M. nepenthicola*              | present                                           | present                         | present                                | 2                    | absent                 |
| *M. nilphamariensis*           | absent                                            | absent                          | absent                                 | 2                    | absent                 |
| *M. okinavisens*               | absent                                            | absent                          | absent                                 | 2                    | absent                 |
| *M. orientalis*                | present                                           | present                         | present                                | 2                    | absent                 |
| *M. ornata*                    | absent                                            | absent                          | absent                                 | 2                    | absent                 |
| *M. palmipes*                  | absent                                            | present                         | absent                                 | 2                    | absent                 |
| *M. perparva*                  | absent                                            | present                         | present                                | 1                    | present               |
| *M. petrigena*                 | present (weak)                                    | present                         | present                                | 1                    | absent                 |
| *M. picta*                     | absent                                            | absent                          | absent                                 | 2                    | absent                 |
| *M. pineticola* s. str.        | present                                           | present                         | present (weak)                         | 2                    | absent                 |
| *M. pulchella*                 | present (weak)                                    | present                         | present (weak)                         | 1 (2)                | absent                 |
| *M. pulchra*                   | absent                                            | absent                          | absent                                 | 2                    | absent                 |
| *M. rubra*                     | absent                                            | absent                          | absent                                 | 2                    | absent                 |
| *M. sholigari*                 | absent                                            | present                         | present                                | 2                    | absent                 |
| *M. superciliaris*             | absent                                            | present                         | present (weak)                         | 2                    | present               |
| *M. taraensis*                 | absent                                            | absent                          | absent                                 | 2                    | absent                 |
| *M. tetrix*                    | absent                                            | present                         | present (weak)                         | 2                    | absent                 |
| *M. zeylanica*                 | absent                                            | present                         | absent                                 | 2                    | absent                 |
Table 4 continued. Morphological comparison between *Microhyla neglecta* sp. nov with 52 currently recognized species of genus *Microhyla*. Members of the *M. achatina* species group are highlighted; ? = no data.

| Species | Light dorsomedial (vertebral) line | Tibiotarsal articulation reaches | Toe webbing formula |
|---------|-----------------------------------|---------------------------------|---------------------|
| *M. neglecta* sp. nov. | present | Well beyond snout | 1I½-2⅔II1¾-3⅔III2⅔-3⅔IV3⅔-4⅔V |
| *M. achatina* | present | To snout or just beyond | I2-2⅔II1⅔-3⅔III2⅔-3⅔IV3⅔-4⅔V |
| *M. annamensis* | absent | Well beyond snout | 1I-2⅔II1-2⅔III1⅔-2⅔IV3-1⅔V |
| *M. annectens* | absent | Well beyond eye | 1I-1III-1III1-1III1⅔-1V3-1⅔V |
| *M. arboricola* | absent | Well beyond snout | 1⅓-2⅔II1⅔-3⅔III2⅔-3⅔IV3-1⅔V |
| *M. aurantiventris* | absent | Slightly beyond snout | 1⅓-2⅔II1⅔-3⅔III2⅔-3⅔IV3-1⅔V |
| *M. beiunensis* | absent | To the eye | Basal |
| *M. berdmorei* | absent | Well beyond snout | 1I-1III1-1III1⅔-1V3-1⅔V |
| *M. borneensis* | absent | Shorter than snout | I2-2⅔II1⅔-3⅔III2⅔-3⅔IV3⅔-4⅔V |
| *M. butleri* | absent | Shorter than snout | I2-2⅔II1⅔-3⅔III2⅔-3⅔IV3⅔-4⅔V |
| *M. chakrapanii* | absent | Beyond snout (?) | Basal |
| *M. darevskii* | absent | Well beyond snout | 1I-1III1-1III1⅔-1V1-1V |
| *M. darrei* | absent | Shorter than eye | I2-2⅔II1⅔-3⅔III2⅔-3⅔IV3-1⅔V |
| *M. eos* | absent | ? | I1⅔-2⅔II1⅔-3⅔III2⅔-3⅔IV3-1⅔V |
| *M. fanjingshanensis* | present | Between eye to nostril | Basal |
| *M. fissipes* | absent | Shorter than snout | I2-2⅔II1⅔-3⅔III2⅔-3⅔IV3⅔-4⅔V |
| *M. fodiens* | absent | Shorter than eye | I2-2⅔II1⅔-3⅔III2⅔-3⅔IV3⅔-4⅔V |
| *M. gadjahmadai* | present | Well beyond snout | I2-2⅔II1⅔-3⅔III2⅔-3⅔IV3⅔-4⅔V |
| *M. heymons* | present | Shorter than snout | I2-2⅔II1⅔-3⅔III2⅔-3⅔IV3⅔-4⅔V |
| *M. hongiaoaensis* | present | Well beyond snout | I2-2⅔II1⅔-3⅔III2⅔-3⅔IV3⅔-4⅔V |
| *M. irrwaddy* | absent | To the eye | I2-2⅔II1⅔-3⅔III2⅔-3⅔IV3⅔-4⅔V |
| *M. karunaratnei* | absent | Beyond snout (?) | I2-2⅔II1⅔-3⅔III2⅔-3⅔IV3⅔-4⅔V |
| *M. kodial* | absent | Well beyond snout | Basal |
| *M. karamotai* | absent | To the eye | I2-2⅔II1⅔-3⅔III2⅔-3⅔IV3⅔-4⅔V |
| *M. laterite* | absent | Well beyond snout | I2-2⅔II1⅔-3⅔III2⅔-3⅔IV3⅔-4⅔V |
| *M. maculifera* | absent | To snout or just beyond | Basal |
| *M. malang* | absent | To snout or just beyond | I2-2⅔II1⅔-3⅔III2⅔-3⅔IV3⅔-4⅔V |
| *M. mantheyi* | absent | Well beyond snout | I2-2⅔II1⅔-3⅔III2⅔-3⅔IV3⅔-4⅔V |
| *M. marmorata* | absent | Well beyond snout | I2-2⅔II1⅔-3⅔III2⅔-3⅔IV3⅔-4⅔V |
| *M. mihiintalei* | absent | To snout | Basal |
| *M. minuta* | absent | Shorter than snout | In-a.n.a.II2-2⅔III2⅔-3⅔IV3⅔-4⅔V |
| *M. mixtura* | absent | Shorter than snout | I2-2⅔II1⅔-3⅔III2⅔-3⅔IV3⅔-4⅔V |
| *M. mukhlesuri* | absent | To snout | I2-2⅔II1⅔-3⅔III2⅔-3⅔IV3⅔-4⅔V |
| *M. mymeningsheni* | absent | To snout | I2-2⅔II1⅔-3⅔III2⅔-3⅔IV3⅔-4⅔V |
| *M. nanopollexa* | absent | Well beyond snout | I2-2⅔II1⅔-3⅔III2⅔-3⅔IV3⅔-4⅔V |
| *M. nepenthicola* | absent | Shorter than snout | I2-2⅔II1⅔-3⅔III2⅔-3⅔IV3⅔-4⅔V |
| *M. nilphamariensis* | absent | To snout | Basal |
| *M. okinawensis* | absent | Beyond eye | I1⅓-2⅔II1⅔-3⅔III2⅔-3⅔IV3⅔-4⅔V |
| *M. orientalis* | present | To the eye | In-a.n.a.II2-2⅔III2⅔-3⅔IV3⅔-4⅔V |
| *M. ornata* | absent | Shorter than snout | I2-2⅔II1⅔-3⅔III2⅔-3⅔IV3⅔-4⅔V |
| *M. palmipes* | absent | To snout or just beyond | In-a.n.a.II2-2⅔III2⅔-3⅔IV3⅔-4⅔V |
| *M. perparva* | absent | Well beyond snout | I1-1III1-1III1⅔-1V2-1V |
| *M. petrigena* | absent | Well beyond snout | I1-1III1-1III1⅔-1V2-1V |
| *M. picta* | absent | Shorter than eye | I2-2⅔II1⅔-3⅔III2⅔-3⅔IV3⅔-4⅔V |
| *M. pineticola s. str.* | present | Shorter than snout | I2-2⅔II1⅔-3⅔III2⅔-3⅔IV3⅔-4⅔V |
| *M. pulchella* | absent | Well beyond snout | I1⅓-2⅔II1⅔-3⅔III2⅔-3⅔IV3⅔-4⅔V |
| *M. pulchra* | absent | To snout or just beyond | I1⅓-2⅔II1⅔-3⅔III2⅔-3⅔IV3⅔-4⅔V |
| *M. rubra* | absent | Shorter than snout | I2⅔-3⅔II1⅔-3⅔III2⅔-3⅔IV3⅔-4⅔V |
| *M. sholigari* | present | Shorter than snout | I1⅓-2⅔II1⅔-3⅔III2⅔-3⅔IV3⅔-4⅔V |
| *M. superneculis* | absent | To snout or just beyond | I1-1III1-1III1⅔-1V2-1V |
| *M. tauraensis* | absent | To the snout | I2-2⅔II1⅔-3⅔III2⅔-3⅔IV3⅔-4⅔V |
| *M. tetrix* | absent | Well beyond snout | I1-1III1-1III1⅔-1V2-1V |
| *M. zeylanica* | absent | To the eye | I2-2⅔II1⅔-3⅔III2⅔-3⅔IV3⅔-4⅔V |
Table 4 continued. Morphological comparison between *Microhyla neglecta* sp. nov with 52 currently recognized species of genus *Microhyla*. Members of the *M. achatina* species group are highlighted; ? = no data.

| Species                  | Distribution                                      | Sources                                      |
|--------------------------|--------------------------------------------------|----------------------------------------------|
| *M. neglecta* sp. nov.   | Vietnam (Langbian pl.)                           | our data                                    |
| *M. achatina*            | Indonesia (Java)                                 | Poyarkov et al. 2014; Atmaja et al. 2018    |
| *M. annamensis*          | Vietnam (Langbian pl.)                           | Poyarkov et al. 2014; our data              |
| *M. anneectens*          | Thailand, Malaysia                               | Parker 1928; Poyarkov et al. 2014; our data |
| *M. arboricola*          | Vietnam (Langbian pl.)                           | Poyarkov et al. 2014                        |
| *M. aurantiiventris*     | Vietnam (Kon Tum pl.)                            | Nguyen et al. 2019                          |
| *M. beilunensis*         | China                                            | Zhang et al. 2018                           |
| *M. berdmorei*           | Indo-Burma and Sundaland                         | Poyarkov et al. 2014; Garg et al. 2018; our data |
| *M. borneensis*          | Malaysia (Borneo)                                | Das & Haas 2010; Matsui 2011                |
| *M. butleri*             | Indo-Burma and Sundaland                         | Poyarkov et al. 2014; 2020a; our data       |
| *M. chakrapanii*         | India (Andamans)                                 | Pilayi 1977                                 |
| *M. darevskii*           | Vietnam (Kon Tum pl.)                            | Poyarkov et al. 2014; our data              |
| *M. darrei*              | India                                            | Garg et al. 2018                            |
| *M. eos*                 | India                                            | Biju et al. 2019                           |
| *M. fanjingshanensis*    | China                                            | Li et al. 2019                              |
| *M. fissipes*            | China, Vietnam                                   | Poyarkov et al. 2014; Garg et al. 2018; our data |
| *M. fodiens*             | Myanmar                                          | Poyarkov et al. 2019                        |
| *M. gadjahmadai*         | Indonesia (Sumatra)                              | Atmaja et al. 2018                          |
| *M. heymonsi*            | Indo-Burma and Sundaland                         | Poyarkov et al. 2014; Garg et al. 2018; our data |
| *M. hongiaoensis*        | Vietnam (Langbian pl.)                           | Hoang et al. 2020                          |
| *M. irrawaddy*           | Myanmar                                          | Poyarkov et al. 2019                        |
| *M. karunarainei*        | Sri Lanka                                        | Garg et al. 2018                            |
| *M. kodial*              | India                                            | Vineeth et al. 2018                         |
| *M. kurokamioi*          | Japan (Yaeyama)                                  | Matsui & Tomiaga 2020                      |
| *M. laterite*            | India                                            | Seshadri et al. 2016                        |
| *M. maculifera*          | Malaysia (Borneo)                                | Poyarkov et al. 2014; our data              |
| *M. malang*              | Malaysia (Borneo)                                | Matsui 2011                                 |
| *M. mantheyi*            | Thailand, Malaysia, Singapore                    | Das et al. 2007; our data                   |
| *M. marmorata*           | Vietnam, Laos                                    | Bain & Nguyen 2004; our data                |
| *M. mihintalei*          | Sri Lanka                                        | Wijayahilaka et al. 2016; Garg et al. 2018  |
| *M. minuta*              | Vietnam (Langbian pl.)                           | Poyarkov et al. 2014; our data              |
| *M. mixtura*             | China                                            | Poyarkov et al. 2014; Zhang et al. 2018     |
| *M. mukhlesuri*          | Bangladesh, Myanmar, Indochina, Thailand         | Hasan et al. 2014; Garg et al. 2018; our study |
| *M. mymensinghensis*     | Bangladesh, India                                | Hasan et al. 2014; Garg et al. 2018         |
| *M. nanopollexa*         | Vietnam (Kon Tum pl.)                            | Bain & Nguyen, 2004; our data               |
| *M. nepenthicolica*      | Malaysia (Borneo)                                | Das & Haas 2010; Matsui 2011                |
| *M. nilphamariensis*     | Bangladesh, Nepal, India, Pakistan               | Howlader et al. 2015; Garg et al. 2018      |
| *M. okinavensis*         | Japan (Miyako, Okinawa, Amami)                   | Matsui & Tomiaga 2020                      |
| *M. orientalis*          | Indonesia                                        | Matsui et al. 2013                          |
| *M. ornata*              | Sri Lanka, India                                 | Poyarkov et al. 2014; Garg et al. 2018      |
| *M. palmipes*            | Indonesia (Sumatra, Nias, Java, Bali)            | Poyarkov et al. 2014                        |
| *M. perparva*            | Malaysia (Borneo)                                | Poyarkov et al. 2014; Inger et al. 2017     |
| *M. petrigena*           | Malaysia (Borneo)                                | Poyarkov et al. 2014; Inger et al. 2017     |
| *M. picta*               | Vietnam (Low central-souther)                    | Poyarkov et al. 2014; our data              |
| *M. pineticola s. str.*  | Vietnam (Langbian pl.)                           | Poyarkov et al. 2014; our data              |
| *M. pulchella*           | Vietnam (Langbian pl.)                           | Poyarkov et al. 2014                        |
| *M. pulchra*             | China, Indochina, Thailand                       | Poyarkov et al. 2014; our data              |
| *M. rubra*               | India                                            | Poyarkov et al. 2014; Garg et al. 2018      |
| *M. sholigari*           | India                                            | Dutta & Ray 2000; Garg et al. 2018          |
| *M. superciliaris*       | Thailand, Malaysia, Indonesia                    | Poyarkov et al. 2014, 2020b                 |
| *M. tarsiensis*          | Nepal                                            | Khatiwada et al. 2017; Garg et al. 2018     |
| *M. tetriss*             | Thailand                                         | Poyarkov et al. 2020b                       |
| *M. zeylanica*           | Sri Lanka                                        | Poyarkov et al. 2014; Garg et al. 2018      |
Discussion

In this paper we report on a new species of the genus *Microhyla* discovered from the montane forests of Langbian Plateau, southern Vietnam. This discovery underscores the high degree of site-specific endemism in isolated montane regions within the Truong Son, or Annamite mountains (e.g. Orlov et al. 2012, Hartmann et al. 2013, Geissler et al. 2015a–b, Chen et al. 2018, Nguyen et al. 2018, 2019, Poyarkov et al. 2017, 2019b). The Langbian Plateau is widely recognized as the centre of herpetofaunal endemism and diversity in Indochina (e.g. Poyarkov & Vassilieva 2011, Nazarov et al. 2012, Vassilieva et al. 2014, Poyarkov et al. 2014, 2015a, 2015b, 2017, 2018, 2019b, Duong et al. 2018, Pauwels et al. 2018). Our discovery of *M. neglecta* brings the total number of species in the genus in Vietnam to 17, with the greatest species diversity and highest degree of local endemism occurring in the Central Highlands—also known as Tay Nguyen—that encompass the Kon Tum and Langbian plateaus. Based on the recent progress in *Microhyla* taxonomy in Vietnam (Poyarkov et al. 2014, Hoang et al. 2020, and this study), up to 12 sympatric species of *Microhyla* are known to co-occur in the montane forests of the Langbian Plateau and its surrounding areas, many of which can be recorded in the same biotope. This is the highest known species density for the genus *Microhyla* in the world, which further highlights the importance of the Langbian Plateau for the evolution and ecological differentiation in this group of frogs (for discussion see Gorin et al. 2020).

The present description of *M. neglecta* is especially interesting as it was confused with its morphologically similar cryptic sister species *M. pineticola* for more than 10 years. In their review, Poyarkov et al. (2014) relied exclusively on morphological characters which they used to distinguish “*M. pineticola* sensu lato” from the morphologically similar widespread species *M. heymonsii*. They reported a significant variation in colouration, pattern, and morphometrics within the type series of *M. pineticola*, but due to the lack of genetic data and sympatric co-occurrence of the two species, they misinterpreted it as a high degree of intraspecific variability (Poyarkov et al. 2014: 100–111). The integrative taxonomic analysis of the material reported by Poyarkov et al. (2014) and the newly collected samples have demonstrated that the diversity hidden within the name “*M. pineticola*” was overlooked. Such situations are rare, but occasionally happen in taxonomic practice. For example, when first discovered, the specimens of a small-sized gecko species *Cnemaspis pseudomcguirei* Grismer, Ahmad, Chan et al., 2009 were confused with juveniles of a larger sympatric species *C. mcguirei* Grismer, Wood & Chan, 2008 (Grismer et al. 2008, 2009). This underscores the key importance of integrative approaches, including molecular data for any taxonomic revision. Not only is this paramount for any downstream analyses, it is now also recognized as a cornerstone of biodiversity conservation (Shaffer et al. 2015). We further stress that in the age of biodiversity crises and molecular genetics, the systematic collection of tissue samples and application of molecular methods is crucial for taxonomic practice in studies of herpetofaunal diversity in Southeast Asia (Smith et al. 2008, Murphy et al. 2013, Chomdej et al. 2020).

In our study we report on two morphologically highly similar (cryptic) species of *Microhyla* frogs, which co-occur sympatrically within their narrow distribution area restricted to the Langbian Plateau of southern Vietnam. Moreover, our phylogenetic analyses have demonstrated that these two cryptic taxa *M. pineticola* and *M. neglecta* are sister species and their age of divergence likely corresponds to middle Miocene (see Gorin et al. 2020). The miniaturized body size of these species (SVL below 23 mm), along with the microendemic pattern of their distribution, suggest that the non-allopatric scenarios for their speciation have to be considered in future (see Wollenberg et al. 2011). Though allopatric speciation has been considered the main process leading to species diversity (Mayr 1982), a number of studies demonstrated that species formation may occur in parapatric or sympatric settings as well (Via 2001, 2009, Seehausen et al. 2008). In amphibians, sympatric scenarios of speciation have only been rarely discussed (see Steinfartz et al. 2007, Vences & Wake 2007, Wollenberg et al. 2011, Vences et al. 2012). The statistical analysis by Wollenberg et al. (2011) suggested that microendemic species of miniaturized frogs tend to speciate more readily and may reject the predominance of allopatric speciation. Interestingly enough, the Langbian Plateau provides further examples of sympatric co-occurrence of sister species in amphibians, such as *Microhyla pulchella* and *M.
Microhyla hongiaoensis (Poyarkov et al. 2014, Hoang et al. 2020), and Ophryophryne gerti (Ohler, 2003) and O. elfina Poyarkov, Duong, Orlov et al. 2017 (Megophryidae; see Poyarkov et al. 2017). We recommend that future studies on adaptive speciation and diversification in amphibians should target the Langbian Plateau, as additional pairs of diverging populations and cryptic species are likely to be found, providing further evidence for the possibility of non-allopatric adaptive speciation in the amphibians in this area or a shared historical environmental history resulting in co-occurring speciation events.

Despite the recent increase in species discoveries, many areas of the Annamites have received comparatively little scientific attention and are very likely to harbour additional, previously unknown species (Poyarkov et al. 2014). The need for biological exploration in this region is made more urgent given the ongoing loss of natural habitats due to logging, road construction, increasing agricultural pressure and other human activities (Meijer 1973, De Koninck 1999, Laurance 2007, Meyfroidt & Lambin 2008, Kuznetsov & Kuznetsova 2011).

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