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A new species of *Amolops* (Anura: Ranidae) from Son La Province, northwestern Vietnam

Anh Van **Pham**[1,2], Cuong The **Pham**[3,4], Hanh Thi **Ngo**[5,6,7], Sung Ba **Nenh**[2], Thomas **Ziegler**[6,7] & Minh Duc **Le**[1,5,8*]

Abstract. A new species of *Amolops* is described from northwestern Vietnam based on morphological and molecular differences. Morphologically, the new species is distinguishable from its congeners on the basis of a combination of the following diagnostic characters: Snout–vent length 37.5–41.3 mm in males, 61.5–62.5 mm in females; head longer than wide; vomerine teeth present; snout long (ratio of distance from tip of snout to anterior corner of eye/snout–vent length 0.16 in males, 0.15 in females); tympanum distinct, round (ratio of eye diameter/tympanum diameter 0.37–0.39 in males, 0.36–0.37 in females); skin smooth; supratympanic fold indistinct; dorsolateral fold present; webbing formula I0—1/2II0—1III0—1IV1—0V; in life, dorsum grey with indistinct greenish dots; head and body with irregular dorsolateral brown stripe; dorsal surface of forelimbs and hindlimbs bright grey with dark brown crossbars; throat, chest and belly white; vocal sac yellowish; external vocal sac present and finger I with nuptial pad in males. In phylogenetic analyses, the new species is recovered as a sister taxon to *A. compotrix*, but the two species are separated by 3.3–3.4% pairwise genetic divergence based on a fragment of the mitochondrial ND2 gene.

Key words. *Amolops*, Muong La District, ND2, new species, taxonomy

INTRODUCTION

Amolops Cope, 1865 is the most species-rich genus in the family Ranidae, containing 73 recognised species with a wide distribution from Nepal and northern India eastwards to China and southwards to Peninsular Malaysia (Frost, 2022). Based on molecular data, Patel et al. (2021) divided the genus *Amolops* into eight groups viz. the *A. daiyunensis* group, the *A. hainanensis* group, the *A. laurentis* group, the *A. mantzorum* group, the *A. marmoratus* group, the *A. monticola* group, the *A. ricketti* group, and the *A. viridimaculatus* group. Among them, the *A. monticola* group is the most diverse with 22 recognised species (Patel et al., 2021). In Vietnam, Frost (2022) has listed 15 species of the genus *Amolops*, including seven of the *A. monticola* group, namely *A. compotrix* (Bain, Stuart & Orlov, 2006), *A. cucae* (Bain, Stuart & Orlov, 2006), *A. daorum* Bain, Lathrop, Murphy, Orlov & Ho, 2003, *A. iriodes* Bain & Nguyen, 2004, *A. mengyangensis* Wu & Tian, 1995, *A. vitreus* Bain, Stuart & Orlov, 2006, and *A. wenshanensis* Yuan, Jin, Li, Stuart & Wu, 2018.

Son La Province is covered by 599,000 hectares of natural forest (People's Committee of Son La Province, 2019). Recent biodiversity research in Son La Province has shown that the evergreen forests of northwestern Vietnam harbour a high level of herpetofaunal diversity. Over the last 10 years, six new species of amphibians and reptiles have been described from Son La Province, namely *Achalinus timi* Ziegler, Nguyen, Pham, Nguyen, Pham, Van Schingen, Nguyen & Le, 2019; *Amolops ottorum* Pham, Sung, Pham, Le, Ziegler & Nguyen, 2019b; *Cyrtodactylus sonlaensis* Nguyen, Pham, Ziegler, Ngo & Le, 2017; *C. taybacensis* Pham, Le, Ngo, Ziegler & Nguyen, 2019a; *Tylototriton anguliceps* Le, Nguyen, Nishikawa, Nguyen, Pham, Matsui, Bernardes & Nguyen, 2015a; and *T. pasmansi obsti* Bernardes, Le, Nguyen, Pham, Pham, Nguyen & Ziegler, 2020. The province is also home to five *Amolops* species, including two from the

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[1]Faculty of Environmental Sciences, University of Science, Vietnam National University, Hanoi, 334 Nguyen Trai Road, Thanh Xuan, Hanoi, Vietnam; Email: phamanh@hus.edu.vn

[2]Tay Bac University, Son La City, Son La Province, Vietnam; Email: sungbanenhttb@gmail.com

[3]Institute of Ecology and Biological Resources, Vietnam Academy of Science and Technology, 18 Hoang Quoc Viet Road, Cau Giay, Hanoi, Vietnam; Email: cuongiebr@gmail.com

[4]Graduate University of Science and Technology, Vietnam Academy of Science and Technology, 18 Hoang Quoc Viet, Cau Giay, Hanoi, Vietnam

[5]Central Institute for Natural Resources and Environmental Studies, Vietnam National University, Hanoi, 19 Le Thanh Tong, Hanoi, Vietnam; Email: ngothihanh.k56@hus.edu.vn

[6]AG Zoologischer Garten Köln, Riehler Strasse 173, D–50735 Cologne, Germany; Email: ziegler@koelnerzoo.de

[7]Institute of Zoology, University of Cologne, Zülpicher Strasse 47b, D–50674 Cologne, Germany

[8]Department of Herpetology, American Museum of Natural History, Central Park West at 79th Street, New York, New York 10024; Email: le.duc.minh@hus.edu.vn (*corresponding author)

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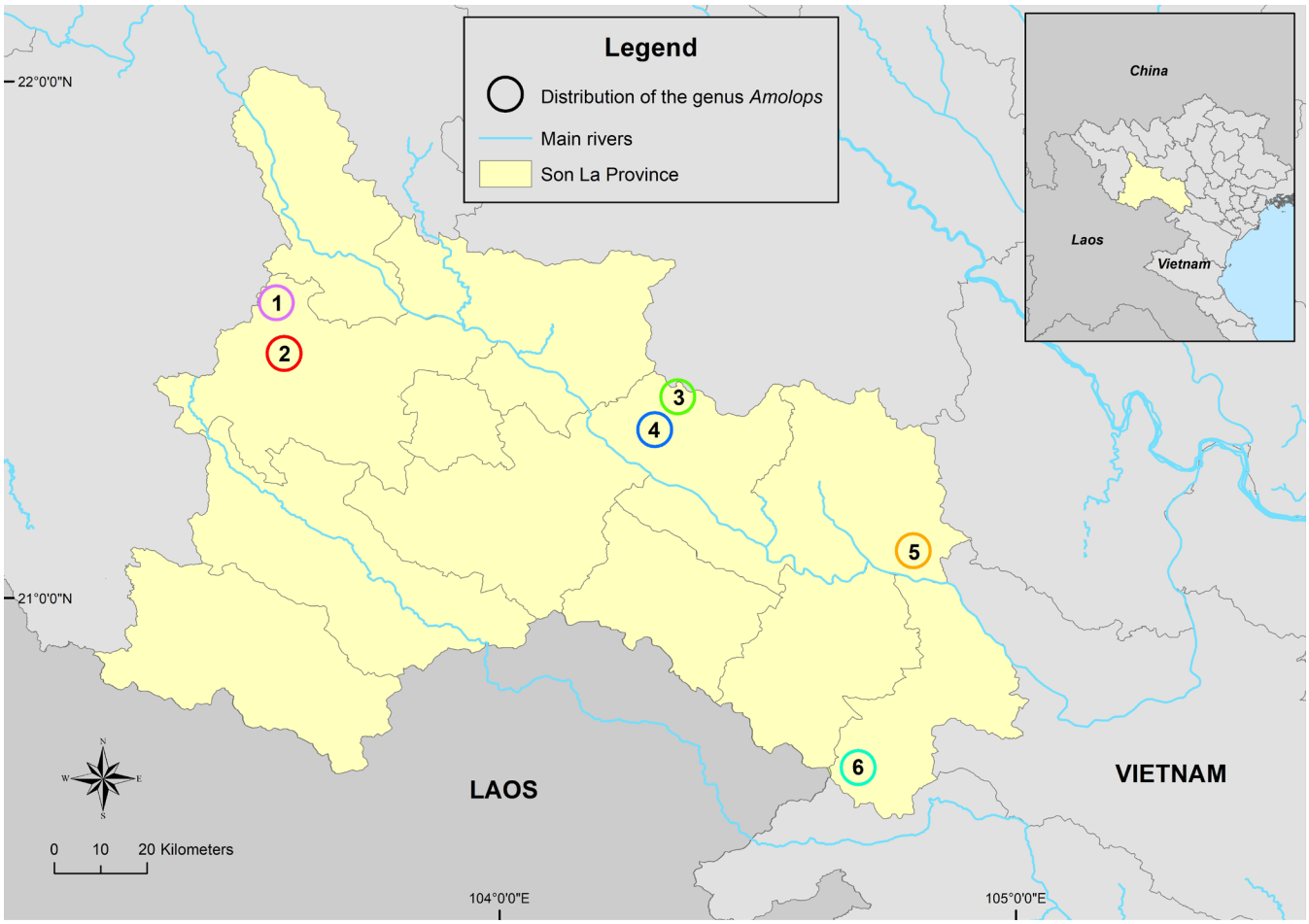

Fig. 1. Distribution of the genus *Amolops* in Son La Province, Vietnam: 1, *A.* cf. *compotrix* in Co Ma Commune, Thuan Chau District; 2, *A. vitreus* in Province in Co Ma Commune, Thuan Chau District; 3, *A. ottorum* in Ngoc Chien Commune, Muong La District; 4, *A. truongi*, new species, in Phieng Ai Commune, Muong La District; 5, *A. ricketti* in Muong Bang Commune, Phu Yen District; and 6, *A. cremnobatus* in Tan Xuan Commune, Van Ho District.

A. ricketti group, *A. ricketti* and *A. cremnobatus* (Nguyen et al., 2009; Pham et al., 2022), one from the *A. martzorum* group, *A. ottorum* (Pham et al., 2019b), and two from the *A. monticola* group, *A.* cf. *compotrix* and *A. vitreus* (Le et al., 2015b; Pham, 2016). While members of the genus are broadly distributed in the province, each taxon is reportedly restricted to a single site (Fig. 1).

During our recent fieldwork in Muong La Nature Reserve, Son La Province, Vietnam, 10 specimens of *Amolops* were collected in the evergreen forest of Ngoc Chien Commune, Muong La District (Fig. 1). These specimens were assigned to the *A. monticola* group based on the following morphological characteristics: dorsal skin smooth, lateral side of head dark, with a light-coloured upper lip-stripe extending to the shoulder, and dorsolateral folds distinct (Stuart et al., 2010; Jiang et al., 2016). However, individuals of the newly discovered population also differ from those of other existing species in a number of morphological characters. We herein describe this taxon as a new species of the *A. monticola* group based on morphological and molecular evidence.

MATERIAL AND METHODS

Sampling. Field surveys were conducted in October and November 2016 in Phieng Ai Village, Ngoc Chien Commune, Muong La District, Son La Province, northwestern Vietnam (Fig. 1). Specimens were collected between 1900 and 2100 hours. After captured individuals were photographed, specimens were euthanised in a closed vessel with a piece of cotton wool containing ethyl acetate (Simmons, 2002), kept in 80% ethanol for eight hours, and then later transferred to 70% ethanol for permanent storage. Tissue samples were preserved separately in 95% ethanol prior to fixation. All type specimens were deposited in the collections of the Zoological Museum, Vietnam National University, Hanoi (ZVNU) and the Institute of Ecology and Biological Resources (IEBR), Hanoi, Vietnam.

Molecular data and phylogenetic analyses. We sequenced two new samples of *Amolops* collected in Muong La District, Son La Province. As the new population possesses morphological characters representing the *A. monticola* species group, we selected as many ingroup taxa of this clade from GenBank as possible. In total, 37 sequences of 21 taxa from the *Amolops monticola* group were incorporated in the phylogenetic analysis. Outgroup polarity was provided

Table 1. Samples used in this study along with their associated vouchers, localities, and GenBank accession numbers. Bold text denotes new samples in this study.

Species	Voucher/Field Number	Locality	GenBank accession no.
Amolops adicola	BNHS 6121	Arunachal Pradesh State, India	MZ231116
Amolops akhaorum	FMNH 271355	Luang Namtha Province, Laos	FJ417207
Amolops akhaorum	FMNH 271406	Luang Namtha Province, Laos	FJ417208
Amolops aniqiaoensis	SYNU04ll6016	Xizang Autonomous Region, China	MN958715
Amolops aniqiaoensis	KIZ011136	Xizang Autonomous Region, China	MN958717
Amolops archotaphus	CUMZ A 2000.62	Chiang Mai, Thailand	FJ417173
Amolops archotaphus	KIZ030888	Chiang Mai, Thailand	MN958719
Amolops bellulus	CAS 233986	Yunnan Province, China	FJ417175
Amolops bellulus	KIZYPX9037	Yunnan Province, China	MN958723
Amolops cucae	AMNH 168727	Lao Cai Province, Vietnam	FJ417193
Amolops cucae	AMNH 168729	Lao Cai Province, Vietnam	FJ417194
Amolops compotrix	FMNH 256499	Khammouane Province, Laos	FJ417185
Amolops compotrix	FMNH 256500	Khammouane Province, Laos	FJ417190
Amolops chunganensis	KIZ03756	Hubei Province, China	MN958729
Amolops daorum	FMNH 255353	Houaphanh Province, Laos	FJ417196
Amolops daorum	ROM 38501	Lao Cao Province, Vietnam	FJ417199
Amolops deng	KIZ014115	Tibet, China	MW111443
Amolops granulosus	SCUM045823HX	Sichuan Province, China	MN958738
Amolops iriodes	AMNH 163926	Ha Giang Province, Vietnam	FJ417201
Amolops iriodes	AMNH 163928	Ha Giang Province, Vietnam	FJ417202
Amolops jinjiangensis	SCUM050434CHX	Yunnan Province, China	MN958757
Amolops jinjiangensis	KIZ047095	Yunnan Province, China	MN958759
Amolops kohimaensis	WIIADA 751	Nagaland State, India	MZ231118
Amolops medogensis	SYNU04II6219	Tibet, China	MN958769
Amolops mengdingensis	KIZ20160265	Yunnan Province, China	MK501814
Amolops mengdingensis	KIZ20160266	Yunnan Province, China	MK501815
Amolops monticola	WIIADA 544	Sikkim State, India	MZ231117
Amolops nyingchiensis	KIZ012629	Tibet, China	MN958773
Amolops nyingchiensis	KIZ016416	Tibet, China	MW133377
Amolops putaoensis	GXNU W011	Kachin State, Myanmar	MT901213
Amolops putaoensis	GXNU W005	Kachin State, Myanmar	MT901214
***Amolops truongi*, new species**	**IEBR 4995**	**Son La Province, Vietnam**	**OP157199**
***Amolops truongi*, new species**	**ZVNU.2022.01**	**Son La Province, Vietnam**	**OP157200**
Amolops tuanjieensis	GXNU YU110003	Yunnan Province, China	MN832756
Amolops tuanjieensis	GXNU YU110006	Yunnan Province, China	MN832757
Amolops tuanjieensis	GXNU YU110007	Yunnan Province, China	MN832758
Amolops tuanjieensis	GXNU YU110034	Yunnan Province, China	MN832759

Species	Voucher/Field Number	Locality	GenBank accession no.
Amolops tuberodepressus	–	Yunnan Province, China	KR559270
Amolops tuberodepressus	SCUM050433CHX	Yunnan Province, China	MN958786
Amolops tuberodepressus	SCUM050430CHX	Yunnan Province, China	MN958787
Amolops tuberodepressus	CAS 234058	Yunnan Province, China	FJ417211
Amolops viridimaculatus	KIZ048488	Yunnan Province, China	MN958789
Amolops viridimaculatus	SCUM050423CHX	Yunnan Province, China	MN958790
Amolops viridimaculatus	SCUM050403CHX	Yunnan Province, China	MN958794
Amolops vitreus	FMNH 258183	Phongsaly Province, Laos	FJ417212
Amolops vitreus	FMNH 258187	Phongsaly Province, Laos	FJ417213
Amolops wenshanensis	KU 292045	Guangxi Province, China	FJ417178
Amolops wenshanensis	KIZ021425	Yunnan Province, China	MG996763
Amolops wenshanensis	IEBR 4503	Quang Ninh Province, Vietnam	OP157201

by sequences of six taxa belonging to the *A. mantzorum* and *A. viridimaculatus* groups based on their phylogenetic relationships with the *Amolops monticola* group (Patel et al., 2021) (Table 1).

Tissue samples were extracted using DNeasy blood and tissue kit, Qiagen (Hilden, Germany). Extracted DNA from the fresh tissue was amplified by DreamTaq PCR mastermix, Thermo Fisher Scientific (Vilnius, Lithuania). A fragment of the mitochondrial NADH dehydrogenase subunit 2 (ND2) was amplified using the primer pair Met-LND2 (5′–CAATGTTGGTTAAAATCCTTCC–3′) and Trp–HND2 (5′–AGGCTTTGAAGGCCTTTGGTC–3′) (Stuart et al., 2006). We opted for this marker because it has been commonly used in recent studies (e.g., Yuan et al., 2018; Wu et al., 2020; Patel et al., 2021). The fragment is also longer than the universally employed 16S ribosomal sequence and rarely contains gaps, making the alignment more straightforward.

For PCR reactions, the volume consisted of 21 µl (10 µl of mastermix, 5 µl of water, 2 µl of each primer at 10 pmol/µl, and 2 µl of DNA or higher depending on the quantity of DNA in the final extraction solution). The PCR conditions were: 95°C for 5 minutes to activate the Taq; with 40 cycles at 95°C for 30 s, 54°C for 45 s, 72°C for 60 s; and the final extension at 72°C for 6 minutes. PCR products were subjected to electrophoresis through a 1% agarose gel, 1st BASE (Selangor, Malaysia). Gels were stained for 10 minutes in 1× TBE buffer at 2 pg/ml of ethidium bromide and visualised under UV light. Successful amplifications were purified to eliminate PCR components using GeneJET™ PCR Purification Kit, Thermo Fisher Scientific (Vilnius, Lithuania). Purified PCR products were sent to Macrogen Inc. (Seoul, South Korea) for sequencing. Sequences generated in this study were aligned with one another using De Novo Assemble function in the program Geneious v.7.1.8 (Kearse et al., 2012).

After sequences were aligned by Clustal X v2 (Thompson et al., 1997), data were analysed using maximum parsimony (MP), as implemented in PAUP*4.0b10 (Swofford, 2001), maximum likelihood (ML), as implemented in IQ-TREE v.1.6.7.1 (Nguyen et al., 2015), and Bayesian inference (BI), as implemented in MrBayes v3.2.7 (Ronquist et al., 2012). For MP analysis, heuristic analysis was conducted with 100 random taxon addition replicates using the tree-bisection and reconnection (TBR) branch swapping algorithm, with no upper limit set for the maximum number of trees saved. Bootstrap support was calculated using 1,000 pseudo-replicates and 100 random taxon addition replicates. All characters were equally weighted and unordered. For ML analysis, we employed a single model of molecular evolution and 10,000 ultrafast bootstrap replications. The optimal model for nucleotide evolution was determined using jModeltest v2.1.4 (Posada & Crandall, 1998).

For Bayesian analyses, we used the optimal model selected by jModeltest with parameters estimated by MrBayes 3.2.1. Two independent analyses with four Markov chains (one cold and three heated) were run simultaneously for 10 million generations with a random starting tree and sampled every 1,000 generations. Log-likelihood scores of sample points were plotted against generation time to determine stationarity of Markov chains. Trees generated before log-likelihood scores reached stationarity were discarded from the final analyses using the burn-in function. The posterior probability values for all clades in the final majority rule consensus tree were provided. The optimal model for nucleotide evolution was set to TIM2+I+G for ML and single-model Bayesian analyses as selected by jModeltest v2.1.4. The cutoff point for the burn-in function was set to 62 (approximately 6% of all trees generated) in the Bayesian analysis, as $-\ln L$ scores reached stationarity after 62,000 generations in both runs. Nodal support was also evaluated using bootstrap replication (BP) as estimated in PAUP, ultrafast bootstrap (UBP) in IQ-TREE, and posterior probabilities (PP) in MrBayes.

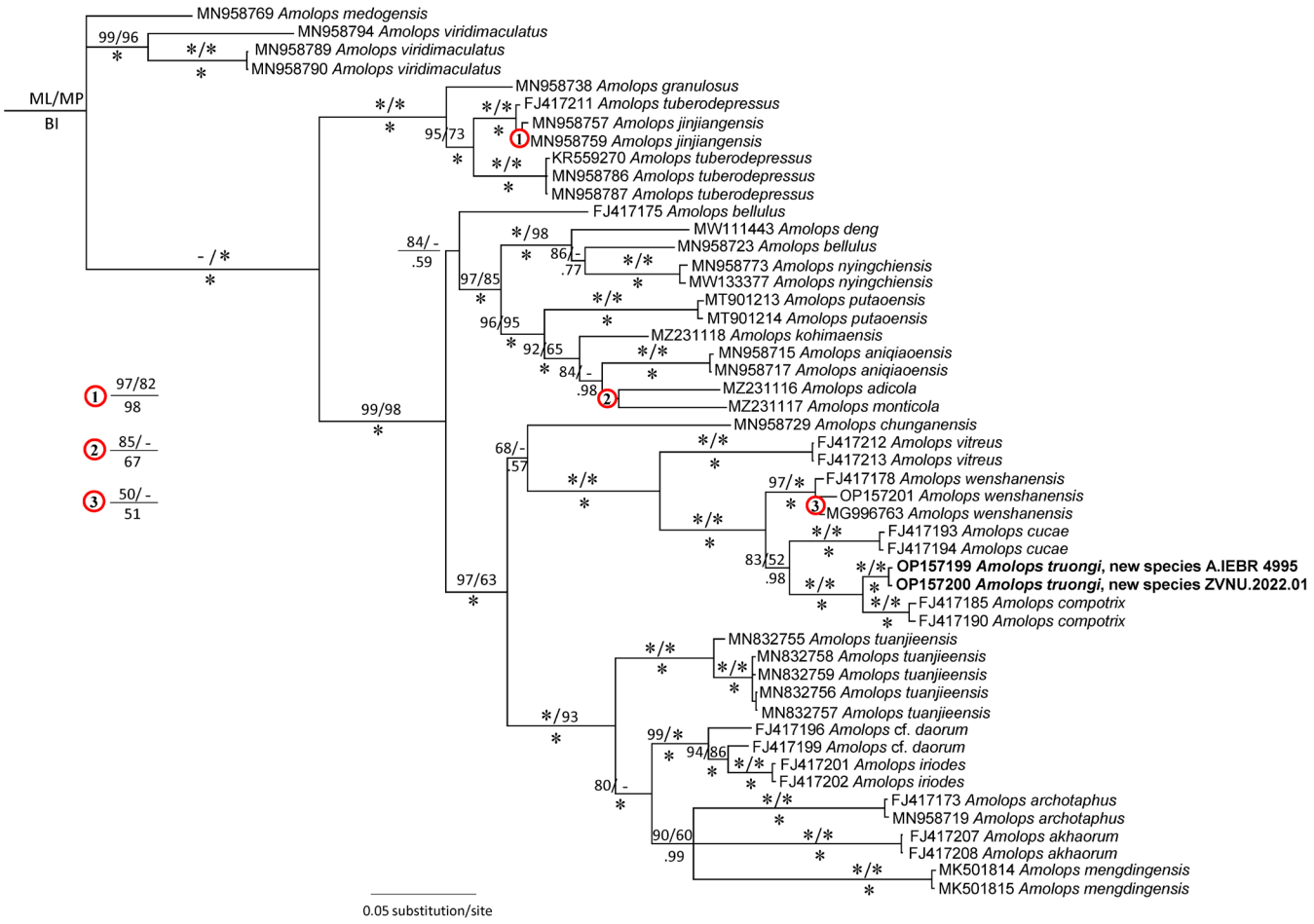

Fig. 2. Phylogram based on the single-model Bayesian analysis. Number above branches are ML ultrafast bootstrap/MP bootstrap values, respectively, and those under branches are Bayesian posterior probabilities (>50%). Asterisks and dashes represent fully supported (100% for BP and UFB and 1.0 for PP) and unsupported nodes, respectively.

BP ≥ 70, and PP and UBP ≥ 0.95 and 95%, respectively, were regarded as strong support for a clade (Hillis & Bull, 1993; Ronquist et al., 2012; Nguyen et al., 2015). Uncorrected pairwise divergences were calculated in PAUP*4.0b10.

Morphological characters. Measurements were taken with a digital caliper to the nearest 0.1 mm. The following abbreviations were used (following Pham et al., 2019a): SVL: snout–vent length (from the back of mandible to tip of snout); AG: axilla to groin (from posterior edge of forelimb insertion to anterior edge of hindlimb insertion); HL: head length (from the back of mandible to tip of snout); HW: maximum head width (across angles of jaws); HD: maximum head height (from occiput to underside of jaws); SE: distance from tip of snout to anterior corner of eye; SND: distance from nostril to the tip of snout; END: eye to nostril distance (distance from anterior corner of eye to the nostril); IND: internarial distance (distance between nostrils); UEW: maximum width of upper eyelid; IOD: interorbital distance; ED: eye diameter; TD: tympanum diameter; TED: tympanum–eye distance (from anterior margin of tympanum to posterior corner of the eye); FLL: forelimb length (from tip of disc of finger III to axilla); NPL: maximal nuptial pad length finger I; FFL: first finger length (from base to tip of finger I); TFL: third finger length (from base to tip of finger III); FTD: maximal width of discs of fingers III; HLL: hindlimb length (from tip of disc of fourth toe to groin); FL: femur length (from vent to knee); TL: tibia length (from knee to tarsus); FOT: length of hindlimb (from tarsus to the tip of fourth toe); FTL: first toe length (from base to tip of toe I); FFTL: fourth toe length (from base to tip of toe IV); HTD: maximal width of discs of fourth toes; MTTi: inner metatarsal tubercles length. For webbing formula, we followed Glaw & Vences (2007). Sex was determined by gonadal inspection.

RESULTS

Phylogenetic analyses. The matrix of molecular data contained 938 characters with no gaps. Our phylogenetic results are generally consistent with those supported by recent studies using the same molecular marker (e.g., Yuan et al., 2018; Patel et al., 2021). However, there are some discrepancies between three different analyses in this study. The major incongruence between BI and ML was the relationship between two outgroup clades. While taxa of the *Amolops viridimaculatus* species group were placed in the most basal position of the phylogenetic tree in BI, they were grouped as a sister clade to the *A. mantzorum* species group with high nodal support (UFB = 99%) in ML. Smaller inconsistencies between the two analyses included the sister

Fig. 3. Dorsolateral (A) and ventral (B) views of the male holotype (ZVNU.2022.01) of *Amolops truongi*, new species, in life. Photo A. V. Pham.

Fig. 4. Dorsolateral view (A) and ventral view (B) of the male holotype (ZVNU.2022.01) of *Amolops truongi*, new species, in preservative. Photo A. V. Pham.

relationship between *A. akhaorum* and *A. mengdingensis* in ML with a low statistical support value (UFB = 65%) vs. unresolved positions of the two taxa with regard to *A. archotaphus* in BI (Fig. 2, Appendix) and several nodes receiving strong nodal values in BI (PP ≥ 0.95) but weak support (UFB < 95%) in ML, most notably for the clade consisting of *A. daorum*, *A. iriodes*, *A. archotaphus*, *A. akhaorum*, and *A. mengdingensis* (UFB = 80%; PP = 1.0).

Although the outgroup positions were consistent between BI and MP, ingroup relationships showed several areas of disagreement. In particular, *A. deng* was placed as a sister taxon to *A. nyingchiensis* in MP with strong support (BP = 73%), whereas the latter clustered with *A. bellulus* in BI and ML with low nodal values (UFB = 86%; PP = 0.77). In addition, *A. daorum* + *A. iriodes* was grouped with *A. tuanjieensis* with a high statistical value (BP = 70%) in MP, while the former formed a sister clade to *A. archotaphus* + *A. akhaorum* and *A. mengdingensis* with significant support coming only from BI (UFB = 80%; PP = 1.0). For the latter clade, *A. archotaphus* was strongly recovered as a sister species to *A. mengdingensis* (BP = 82%) but the two species and *A. akhaorum* became unresolved in BI (Fig. 2, Appendix). The population from Muong La District, Son La Province was placed as the sister taxon to *Amolops compotrix* from Laos and Vietnam with full statistical support in all analyses (Fig. 2). Genetically, the two taxa are approximately 3.3–3.4% divergent from each other based on a fragment of the mitochondrial ND2 gene used in the study. The taxon from Son La differs from other species in the *A. monticola* species group from ~6.6% (*A. wenshanensis*) to ~18.4% (*A. archotaphus*).

SYSTEMATICS

Family Ranidae Batsch, 1796

Genus *Amolops* Cope, 1865

Amolops truongi, new species
(Figs. 3–6)

Holotype. ZVNU.2022.01 (Field No.SL 2016.344), adult male, collected by N. B. Song and T. V. Dau on 29 October 2016 in the forest near Phieng Ai Village (21°34.956′N, 104°17.160′E, at an elevation of 1,360 m a.s.l.), Ngoc Chien Commune, Muong La District, Son La Province, Vietnam.

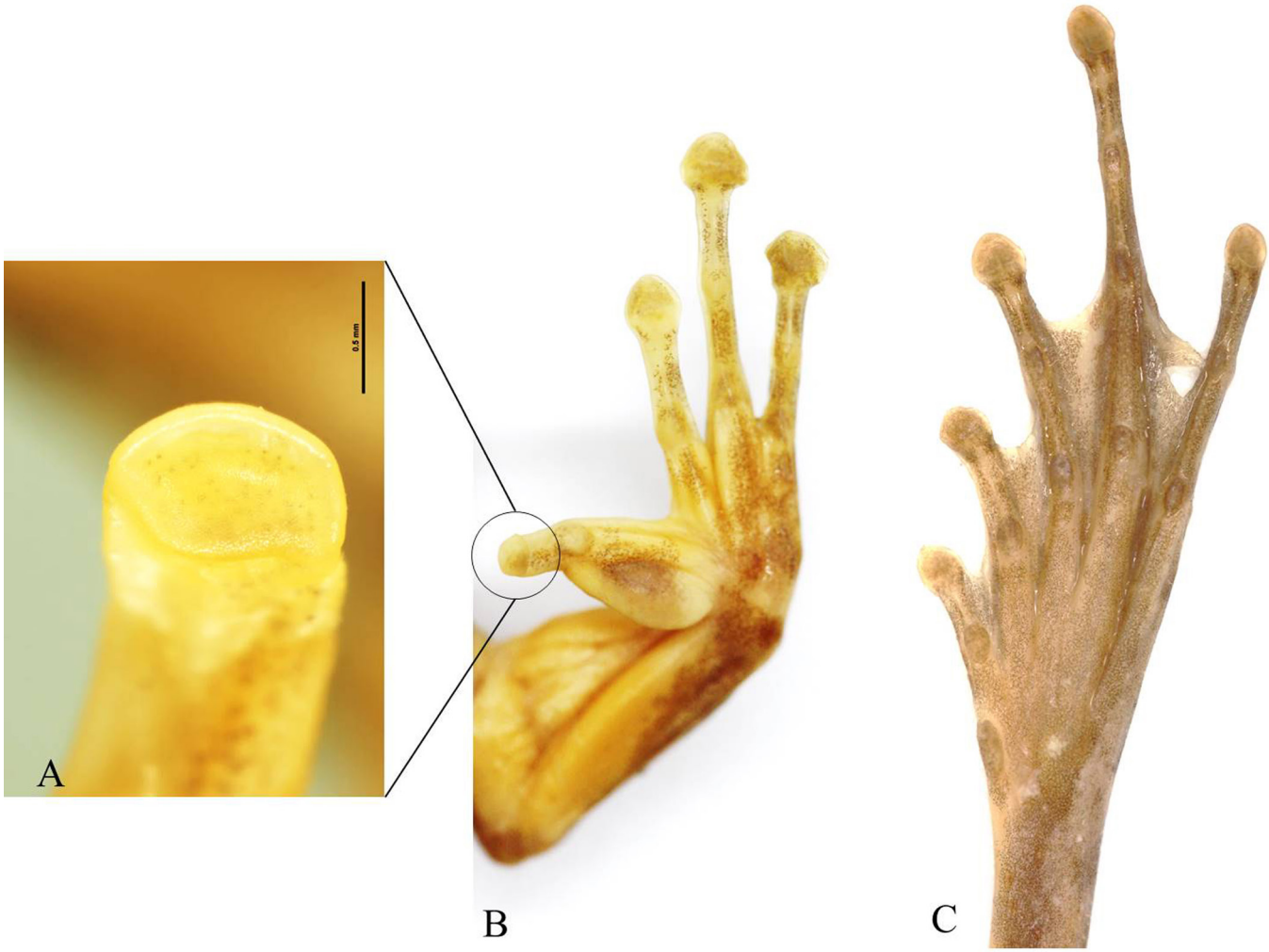

Fig. 5. *Amolops truongi*, new species, male holotype (ZVNU.2022.01) in preservative. A, disc of first finger; B, underside palmar view of left hand; C, underside palmar view of right foot. Photo: A. V. Pham.

Paratypes. ZVNU.2022.02 (Field No.SL 2016.342), IEBR A.4993 (Field No.SL 2016.346), ZVNU.2022.03 (Field No.SL 2016.347), IEBR A.4994 (Field No.SL 2016.348), IEBR A.4995 (Field No.SL 2016.349), ZVNU.2022.04 (Field No.SL 2016.352), adult males; ZVNU.2022.05 (Field No.SL 2016.339), ZVNU.2022.06 (Field No.SL 2016.340) & IEBR A.4996 (Field No.SL 2016.343), adult females (the same data as the holotype).

Diagnosis. The new species from Son La Province is assigned to the *Amolops monticola* group on the basis of the following morphological characters: dorsal skin smooth, lateral side of head dark, with a light-coloured upper lip-stripe extending to the shoulder, and dorsolateral folds distinct (Stuart et al., 2010; Jiang et al., 2016). The new species is also supported as a member of the *A. monticola* group based on the molecular data (Fig. 2). *Amolops truongi*, new species, is distinguishable from its congeners by a combination of the following morphological characters: (1) SVL 37.5–41.3 mm in males, 61.5–62.5 mm in females; (2) head longer than wide; (3) vomerine teeth present; (4) snout long (SE/SVL 0.16 in males, 0.15 in females); (5) tympanum distinct, round (TD/ED 0.37–0.39 in males, 0.36–0.37 in females); (6) skin smooth; (7) supratympanic fold indistinct; (8) dorsolateral fold present; (9) webbing formula I0–1/2II0–1III0–1IV1–0V; (10) in life, dorsum lightly grey with indistinct greenish dots or greenish spots; (11) head and body with irregular dorsolateral brown stripe; (12) dorsal surface of forelimbs and hindlimbs light grey with brown crossbars, darker on hindlimbs; (13) throat, chest and belly white; vocal sac yellowish; (14) external vocal sac present and finger I with nuptial pad in males.

Description of holotype. Adult male; SVL 41.3 mm; body long (AG/SVL 0.45); head large, broad and flat (HL/SVL 0.33, HW/SVL 0.31, HD/SVL 0.15), longer than wide (HL 14.6 mm, HW 13.0 mm); snout point anteriorly in dorsal view (SE/SVL 0.16), projecting beyond lower jaw; nostril lateral, closer to snout tip than to eye (SND 3.0 mm, END 3.6 mm); canthus rostralis distinct; loreal region concave; snout length greater than eye diameter (SE 6.6 mm, ED 5.9 mm); eyes very large (ED/HL 0.40, ED/SE 0.89 mm); pupil horizontally oval; internarial distance wider than interorbital distance and upper eyelid (IND 4.5 mm, IOD 3.5 mm, UEW 4.0 mm); tympanum distinct, round (TD/ED 0.36); vomerine teeth present, on two short oblique, cresentic ridges between choanae; tongue cordiform, notched posteriorly; vocal sac opening on floor of mouth at corner, sac-like gular pouch, front margin positioned near to level of centre of orbit.

Fig. 6. Dorsolateral view of the female paratype (ZVNU.2022.06) of *Amolops truongi*, new species, in life. Photo A. V. Pham.

Forelimbs long (FLL/SVL 0.69); forearm very robust; relative finger lengths: I<II<IV<III; fingers without webbing; tips of fingers expanded into discs, second to fourth with circummarginal grooves; tip of first finger smaller, without circummarginal groove; width of disc of finger III smaller than the diameter of tympanum (TD 2.2 mm, FTD 1.5 mm); subarticular tubercles oval, formula 1, 1, 2, 2; metatarsal tubercle indistinct; glandular nuptial pad on finger I, covering medial surface to base of finger disc.

Hindlimbs very long (HLL/SVL 1.86); tibia longer than thigh (FL 21.1 mm, TL 24.8 mm); relative toe length I<II<III<V<IV; tips of toes expanded into discs; width of disc of toe IV smaller than that of finger III; webbing formula I0–1/2II0–1III0–1IV1–0V; subarticular tubercles oval, formula 1, 1, 2, 3, 2; inner metatarsal tubercle elongate; outer metatarsal tubercle absent.

Skin texture in life. Dorsal and lateral of head and body smooth, except few very small tubercles present on temporal head, above tibias and vent; supratympanic fold indistinct; dorsolateral fold distinct, from rear of upper eyelid to near vent; ventral surfaces smooth except lightly flat tubercles on basal ventral surface of thigh.

Colouration in life. Dorsum light grey with scattered small, indistinct greenish dots; head and body with irregular dorsolateral brown stripes; lateral side of head and tympanum brown; flanks light grey; a white stripe extending from the tip of the snout to the anterior joint of the shoulder on each side; gold around iris; dorsal surface of forelimbs and hindlimbs light grey with brown crossbars, darker on hindlimbs; throat, chest and belly white; vocal sac yellowish; ventral surface of forelimbs and hindlimbs slightly cream; toe webbing brown.

Colouration in preservative. Dorsal surface of the head and body dark grey; upper margins of the dorsolateral fold, side of head and tympanum dark brown; side of flanks yellowish; dorsal surface of forelimbs and hindlimbs lightly brown with dark crossbars; throat, chest and belly white with some brownish dots.

Fig. 7. A, Dorsolateral view of the adult male of *Amolops compotrix*, photo C. T. Pham from Thua Thien Hue Province, Vietnam; B, the adult male and female of *Amolops cucae*, photo, T. Q. Nguyen from Lao Cai Province, Vietnam.

Sexual dimorphism and variation. Males have distinct vocal sacs (absent in females), distinct nuptial pads on finger I (absent in females), and thick, robust forearms (forearms thin and slender in females). In terms of colouration pattern, dorsal surface of head and body is light grey with some greenish spots in one adult male ZVNU.2022.04 and one adult female IEBR A.A.4996. Measurements and morphological characters of the type series are given in Table 2.

Etymology. The species was named after the eminent zoologist from the Institute of Ecology and Biological Resources, Vietnam Academy of Science and Technology, Prof. Dr. Truong Quang Nguyen, who has made tremendous contributions to the study of Vietnam's herpetofauna.

Distribution. *Amolops truongi*, new species, is currently known only from the type locality in Muong La District, Son La Province, Vietnam (Fig. 1).

Ecological notes. Specimens were found at night between 1830 and 2100 hours, on trees or limestone cliffs nearby a stream, about 0.3–1.0 m above the ground, at elevations between 1,200 and 1,400 m a.s.l. The surrounding habitat was secondary forest of medium with shrubs. Air temperature was 20–25°C and relative humidity was 75–85%. Other amphibian

species found at the site were *Odorrana chapaensis* (Bourret, 1937), *O. jingdongensis* Fei, Ye & Li, 2001, *O. nasica* (Boulenger, 1903), *Kurixalus bisacculus* (Taylor, 1962), and *Polypedates mutus* (Smith, 1940).

Comparisons. Morphological character analyses clearly indicate that the new species belongs to the *A. monticola* group. We compared the new species with other members of the *A. monticola* group and data obtained from the literature (Boulenger, 1920; Pope, 1929; Ray, 1992; Wu & Tian, 1995; Inger & Chanard, 1997; Liu et al., 2000; Bain et al., 2003, 2006; Bain & Nguyen, 2004; Zhao et al., 2005; Fei et al., 2009, 2010; Biju et al., 2010; Stuart et al., 2010; Jiang et al., 2016; Yuan et al., 2018; Yu et al., 2019; Che et al., 2020; Gan et al., 2020a, b; Patel et al., 2021) (Table 3).

Amolops truongi, new species, differs from from *A. compotrix* (Bain, Stuart & Orlov, 2006) by having a larger size (SVL mean ± SD 39.5 ± 1.5 mm [n = 7] vs. 36.8 ± 3.1 mm [n = 10] in males; 62.1 ± 0.55 mm [n = 3] vs. 56.4 ± 0.7 mm [n = 3] in females), a lower ratio of TD/ED (0.37 vs. 0.41–0.51 in males; 0.36–0.37 vs. 0.41–0.45 in females; Tables 2, 4), the absence of circummarginal grooves on disc of grooves on disc of first finger and outer metatarsal tubercle on the hindlimbs (vs. present), and different dorsal colour pattern (light grey with scattered small, indistinct greenish dots vs. bluish green) (Fig. 7A); from *A. cucae* (Bain, Stuart & Orlov, 2006) by having a smaller size in females (SVL 61.5–62.5 mm vs. 65.8–68.0 mm), the absence of circummarginal grooves on disc of grooves on disc of first finger and outer metatarsal tubercle on the hindlimbs (vs. presence), and different dorsal colour pattern (light grey with scattered small, indistinct greenish dots vs. light green) (Fig. 7B); from *A. adicola* Patel, Garg, Das, Stuart & Biju, 2021 by having a smaller size in males (SVL 37.5–41.3 mm vs. 44.0–47.0 mm), the absence of circummarginal grooves on disc of first finger (vs. presence), and different dorsal colour pattern (light grey with scattered small, indistinct greenish dots vs. reddish brown); from *A. akhaorum* Stuart, Bain, Phimmachak & Spence, 2010 by having a larger size in males (SVL 37.5–41.3 mm vs. 34.9–37.2 mm), the absence of circummarginal grooves on disc of first finger (vs. presence), and different dorsal colour pattern (light grey with scattered small, indistinct greenish dots vs. green with distinct brown mottling); from *A. aniqiaoensis* Dong, Rao & Lü, 2005 by having a larger size in females (SVL 61.5–62.5 mm vs. 52.0 mm), tympanum visible (vs. invisible), the absence of circummarginal grooves on disc of first finger (vs. presence), and different dorsal colour pattern (light grey with scattered small, indistinct greenish dots vs. green); from *A. archotaphus* Inger & Chanard, 1997 by the absence of circummarginal grooves on disc of first finger (vs. presence), the absence of outer metatarsal tubercle on the hindlimbs (vs. presence), dorsolateral fold distinct (vs. weak or absence), and different dorsal colour pattern (light grey with scattered small, indistinct greenish dots vs. olive green, with irregularly distributed small brown spots); from *A. bellulus* Liu, Yang, Ferraris & Matsui, in Liu, Yang, Ferraris, Matsui & Price (2000), by having a smaller size (SVL 37.5–41.3 mm in males, 61.5–62.5 mm in females vs. 45.9–50.1 mm in males, 63.6 mm in females, respectively), the presence of vocal sac in males (vs. absence), and different dorsal colour pattern (light grey with scattered small, indistinct greenish dots vs. olive green with brown spots); from *A. chakrataensis* Ray, 1992 by having a larger size in females (SVL 61.5–62.5 mm vs. 55.0 mm), head longer than wide (vs. head wider than long), and different dorsal colour pattern (light grey with scattered, indistinct greenish dots vs. reddish brown); from *A. chunganensis* (Pope, 1929) by having a larger size in females (SVL 61.5–62.5 mm vs. 44.0–54.0 mm), the absence of circummarginal grooves on disc of grooves on disc of first finger (vs. presence), and different dorsal colour pattern (light grey with scattered small, indistinct greenish dots vs. reddish brown); from *A. daorum* (Bain et al.) by having a larger size (SVL mean ± SD 39.5 ± 1.5 mm [n = 7] vs. 35 ± 1.5 mm [n = 8] in males; 62.1 ± 0.55 mm [n = 3] vs. 50 ± 1.2 mm [n = 8] in females), the absence of circummarginal grooves on disc of grooves on disc of first finger (vs. presence), the presence of two oblique vomerine ridges (vs. absence), and different dorsal colour pattern (light grey with scattered small, indistinct greenish dots vs. green with black spots). *Amolops truongi*, new species, differs from *A. deng* Che, Jiang, Yan & Zhang, 2020 by having a smaller size (SVL 37.5–41.3 mm in males, 61.5–62.5 mm in females vs. 50.3–57.6 mm in males, 68.5–72.0 mm in females), the absence of circummarginal grooves on disc of grooves on disc of first finger (vs. presence), and different dorsal colour pattern (light grey with scattered small, indistinct greenish dots vs. brown); the new species differs from *A. gerbillus* (Annandale, 1912) by having a smaller size in males (SVL 37.5–41.3 mm vs. 66.0 mm), tympanum visible (vs. invisible), and different dorsal colour pattern (light grey with scattered small, indistinct greenish dots vs. reddish brown); from *A. iriodes* (Bain & Nguyen) by having a smaller size in females (SVL 61.5–62.5 mm vs. 63.0 mm), the absence of circummarginal grooves on disc of grooves on disc of first finger (vs. presence), and different dorsal colour pattern (light grey with scattered small, indistinct greenish dots vs. iridescent light green with some black spots); from *A. kohimaensis* Biju, Mahony & Kamei, 2010 by having a smaller size in males (SVL 37.5–41.3 mm vs. 42.8–48.6 mm) and different dorsal colour pattern (light grey with scattered small, indistinct greenish dots vs. brown); from *A. mengdingensis* Yu, Wu & Yang, 2019 by having a smaller size in females (SVL 61.5–62.5 mm vs. 64.3 mm), the absence of circummarginal grooves on disc of grooves on disc of first finger (vs. presence), and different dorsal colour pattern (light grey with scattered small, indistinct greenish vs. green); from *A. mengyangensis* Wu & Tian, 1995 by the presence of two oblique vomerine ridges (vs. absence), the absence of circummarginal grooves on disc of grooves on disc of first finger (vs. presence), and different dorsal colour pattern (light grey with scattered small, indistinct greenish dots vs. olive brown); from *A. monticola* (Anderson, 1871) by having a smaller size in females (SVL 61.5–62.5 mm vs. 66.0–75.0 mm), head longer than wide (vs. head as wide as long), the presence of dorsolateral fold (vs. absence), and the absence of circummarginal grooves on disc of grooves on disc of first finger (vs. presence); the new species differs from *A. nyingchiensis* Jiang, Wang, Xie, Jiang & Che, 2016

Table 2. Measurements (in mm) and proportions of the type series of *Amolops truongi*, new species (for other abbreviations, see Material and Methods).

Character	ZVNU.2022.01	ZVNU.2022.04	ZVNU.2022.03	IEBR 4995	ZVNU.2022.02	IEBR.4993	IEBR 4994	Min–Max	mean ± SD	ZVNU.2022.05	ZVNU.2022.06	IEBR 4996	Min-Max	mean ± SD
	SL.2016.344	SL.2016.352	SL.2016.347	SL.2016.349	SL.2016.342	SL.2016.346	SL.2016.348			SL.2016.339	SL.2016.340	SL.2016.343		
	Holotype Male	Paratype Male	Paratype Male	Paratype Male	Paratype Male	Paratype Male	Paratype Male			Paratype Female	Paratype Female	Paratype Female		
SVL	41.3	40.2	39.4	38.5	41.3	37.5	38	37.5–41.3	39.5±1.5	62.4	61.5	62.5	61.5–62.5	62.1±0.55
AG	18.6	17.5	17.6	17.4	18.9	17.3	17.8	17.3–18.9	17.9±0.6	29.8	29.5	28.2	28.2–29.8	29.2±0.85
HL	14.6	14.4	14	13.6	15	13.4	13.6	13.4–15	14.1±0.6	21.6	21.5	22.5	21.5–22.5	21.9±0.55
HW	13.0	13.7	13.0	13.0	13.8	12.0	12.0	12.0–13.8	12.9±0.7	20.0	20.5	20.0	20.0–20.5	20.2±0.29
HD	6.4	6.3	6.1	5.6	6.6	5.8	6.2	5.6–6.6	6.1±0.3	9.5	9.0	9.2	9.0–9.5	9.2±0.25
SE	6.6	6.5	6.5	6.2	6.7	6.1	6.2	6.1–6.7	6.4±0.2	9.3	9.2	9.2	9.2–9.3	9.2±0.06
SND	3.0	3.1	3.2	2.7	3.1	3.0	2.9	2.7–3.2	3.0±0.2	4.4	4.4	4.6	4.4–4.6	4.5±0.12
END	3.6	3.3	3.5	2.9	3.5	3.1	3.2	2.9–3.6	3.3±0.3	5.2	5.0	5.1	5–5.2	5.1±0.1
IND	4.5	4.7	4.7	4.3	4.7	4.2	4.3	4.2–4.7	4.5±0.2	6.0	6.5	6.5	6.0–6.5	6.3±0.29
UEW	4.0	4.0	3.9	4.0	4.2	3.8	3.9	3.8–4.2	4.0±0.1	5.5	6.0	5.5	5.5–6.0	5.7±0.29
IOD	3.5	3.6	3.5	3.4	3.7	3.3	3.2	3.2–3.7	3.5±0.2	4.7	4.8	5.1	4.7–5.1	4.9±0.21
ED	5.9	5.5	5.9	5.6	6.0	5.3	5.6	5.3–6	5.7±0.3	8.1	8	8.1	8–8.1	8.1±0.06
TD	2.2	2.1	2.2	2.2	2.2	2.0	2.1	2.0–2.2	2.1±0.1	3.0	2.9	3.0	2.9–3.0	3±0.06
TED	1.4	1.4	1.3	1.2	1.6	1.2	1.5	1.2–1.6	1.4±0.1	2.5	2.6	2.7	2.5–2.7	2.6±0.1
FLL	28.3	26.0	28.2	26.4	29.0	26.3	27.5	26–29	27.4±1.2	41.4	40.2	40.0	40–41.4	40.5±0.76
FFL	2.8	3.0	3.3	2.3	3.1	3.0	2.9	2.3–3.3	2.9±0.3	4.8	4.8	4.9	4.8–4.9	4.8±0.06
TFL	6.7	7.2	7.5	7.3	7.3	6.5	6.1	6.1–7.5	6.9±0.5	10.9	10.5	10.6	10.5–10.9	10.7±0.21
FTD	1.5	1.7	1.8	1.3	2.0	1.3	1.3	1.3–2	1.6±0.3	2.3	2.3	2.5	2.3–2.5	2.4±0.12
NPL	3.8	3.9	3.3	3.3	3.7	3.0	3.3	3–3.9	3.5±0.3				0–0	
HLL	77.0	74.3	72.0	70.0	79.8	69.4	73.0	69.4–79.8	73.6±3.7	110.5	109.0	112.0	109.0–112.0	110.5±1.5
FL	21.1	20.5	20.0	18.9	21.5	18.8	19.2	18.8–21.5	20.0±1.1	30.0	32.0	32.7	30–32.7	31.6±1.4
TL	24.8	24.5	24.9	23.6	25.7	23.3	24.9	23.3–25.7	24.5±0.8	37.2	38.0	37.8	37.2–38.0	37.7±0.42
FOT	33.7	31.5	33.0	30.4	34.6	30.1	31.5	30.1–34.6	32.1±1.7	48.6	48.9	50.2	48.6–50.2	49.2±0.85
FTL	3.2	3.6	3.4	2.9	3.6	2.5	3.1	2.5–3.6	3.2±0.4	5.6	5.0	5.5	5.0–5.6	5.4±0.32
FFTL	12.5	12.7	12.0	10.9	12.7	10.8	11.2	10.8–12.7	11.8±0.8	18.2	17.4	18.4	17.4–18.4	18±0.53

Character	ZVNU.2022.01	ZVNU.2022.04	ZVNU.2022.03	IEBR 4995	ZVNU.2022.02	IEBR.4993	IEBR 4994	Min–Max	mean ± SD	ZVNU.2022.05	ZVNU.2022.06	IEBR 4996	Min–Max	mean ± SD
	SL.2016.344	SL.2016.352	SL.2016.347	SL.2016.349	SL.2016.342	SL.2016.346	SL.2016.348			SL.2016.339	SL.2016.340	SL.2016.343		
	Holotype Male	Paratype Male	Paratype Male	Paratype Male	Paratype Male	Paratype Male	Paratype Male			Paratype Female	Paratype Female	Paratype Female		
HTD	1.2	1.2	1.2	0.8	1.4	0.9	0.8	0.8–1.4	1.1±0.2	2.0	1.7	1.9	1.7–2.0	1.9±0.15
MTTi	1.5	1.6	1.7	1.4	1.6	1.5	1.5	1.4–1.7	1.5±0.1	2.3	2.2	2.2	2.2–2.3	2.2±0.06
AG/SVL	0.45	0.44	0.45	0.45	0.46	0.46	0.47	0.44–0.47	0.45±0.01	0.48	0.48	0.45	0.45–0.48	0.47±0.02
HL/SVL	0.35	0.36	0.36	0.35	0.36	0.36	0.36	0.35–0.36	0.36±0	0.35	0.35	0.36	0.35–0.36	0.35±0.01
HW/SVL	0.31	0.34	0.33	0.34	0.33	0.32	0.32	0.31–0.34	0.33±0.01	0.32	0.33	0.32	0.32–0.33	0.32±0.01
HD/SVL	0.15	0.16	0.15	0.15	0.16	0.15	0.16	0.15–0.16	0.16±0.01	0.15	0.15	0.15	0.15–0.15	0.15±0
SE/SVL	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16±0	0.15	0.15	0.15	0.15–0.15	0.15±0
ED/HL	0.40	0.38	0.42	0.41	0.40	0.40	0.41	0.38–0.42	0.4±0.01	0.38	0.37	0.36	0.36–0.38	0.37±0.01
ED/SE	0.89	0.85	0.91	0.90	0.90	0.87	0.90	0.85–0.91	0.89±0.02	0.87	0.87	0.88	0.87–0.88	0.87±0.01
TD/ED	0.37	0.38	0.37	0.39	0.37	0.38	0.38	0.37–0.39	0.38±0.01	0.37	0.36	0.37	0.36–0.37	0.37±0
FLL/SVL	0.69	0.65	0.72	0.69	0.70	0.70	0.72	0.65–0.72	0.69±0.03	0.66	0.65	0.64	0.64–0.66	0.65±0.01
HLL/SVL	1.86	1.85	1.83	1.82	1.93	1.85	1.92	1.82–1.92	1.87±0.04	1.77	1.77	1.79	1.77–1.79	1.78±0.01

by having a smaller size in males (SVL 37.5–41.3 mm vs. 48.5–58.3 mm), the presence of vocal sac in males (vs. absence), and the absence of circummarginal grooves on disc of grooves on disc of first finger (vs. presence); from *A. putaoensis* Gan, Qin, Lwin, Li, Quan, Liu & Yu, 2020 by the absence of circummarginal grooves on disc of grooves on disc of first finger (vs. presence), head longer than wide (vs. head wider than long), and different dorsal colour pattern (light grey with scattered small, indistinct greenish dots vs. brown with dark spots); from *A. tuanjieensis* Gan, Yu & Wu, 2020 by having a larger size in females (SVL 61.5–62.5 mm vs. 56.8–60.7 mm), the absence of circummarginal grooves on disc of grooves on disc of first finger and outer metatarsal tubercle on the hindlimbs (vs. presence), and different dorsal colour pattern (light grey with scattered small, indistinct greenish dots vs. green with dark brown stippling and large brown spots that concentrate near sacrum); from *A. vitreus* (Bain, Stuart & Orlov, 2006) by the absence of circummarginal grooves on disc of first finger (vs. presence), the absence of outer metatarsal tubercle on the hindlimbs (vs. presence), and different dorsal colour pattern (light grey with scattered small, indistinct greenish dots vs. green with dark brown stippling and large brown spots that concentrate near sacrum); from *A. wenshanensis* Yuan, Jin, Li, Stuart & Wu, 2018 by having a larger size in females (SVL 61.5–62.5 mm vs. 43.7–45.6 mm), the absence of circummarginal grooves on disc of first finger (vs. present), and different dorsal colour pattern (light grey with scattered small, indistinct greenish dots vs. light green in *A. wenshanensis*) (Tables 2, 3).

DISCUSSION

Over the last five years, 24 additional species have been described within the genus *Amolops* (Frost, 2022). Three of the species, i.e., *A. ottorum*, *A. shihaitaoi*, and *A. wenshanensis* were either discovered or recorded in Vietnam (Pham et al., 2019; 2020; Wang et al., 2022). Our discovery, the fourth new species documented in the country within the same period, brings the number of *Amolops* species in Son La Province to six, and in Vietnam to 16. Although pairwise genetic distance shows slight divergence (3.3–3.4%) between the new species and *Amolops compotrix* based on a fragment of the mitochondrial ND2 gene, the new species significantly differs from *A. compotrix* in terms of morphology. Specifically, the new species can be clearly distinguished from *A. compotrix* by having a larger size; a lower ratio of TD to ED; the absence of circummarginal grooves on disc of first finger and outer metatarsal tubercle on the hindlimbs (vs. presence); relative tympanum diameter of males small compared to females (vs. equal or near equal), and dorsal colour pattern (light grey with scattered small, indistinct greenish dots vs. bluish green) (Table 4).

Son La currently harbours three species of the *Amolops monticola* group, including *A.* cf. *compotrix*, *A. truongi*, new species, and *A. vitreus*. Pham (2016) reported the occurrence of *Amolops compotrix* in Son La Province. However, the record is around more than 700 km from three locations,

Table 3. Morphological comparisons between *Amolops truongi,* new species with other members of the genus *Amolops* (morphological data obtained from the literature: Boulenger, 1920; Pope, 1929; Ray, 1992; Wu & Tian, 1995; Inger & Chanard, 1997; Liu et al., 2000; Bain et al., 2003, 2006; Bain & Nguyen, 2004; Zhao et al., 2005; Fei et al., 2009, 2010; Biju et al., 2010; Stuart et al., 2010; Jiang et al., 2016; Yuan et al., 2018; Yu et al., 2019; Che et al., 2020; Gan et al., 2020a,b; Patel et al., 2021). Abbreviations are as follows: ? = characters unobtainable from literature; Y = Present; N = Absent; for other abbreviations see Material and Methods.

	SVL (mm)		Head longer and wide	Vocal sac in males	Dorsolateral fold	Tympanum	Groove on disc of first finger	Two oblique vomerine ridges	Outer metatarsal tubercle (Hindlimbs)	Dorsal colour in life
	Males	Females								
***A. truongi*, new species**	**37.5–41.3**	**61.5–62.5**	**HL>HW**	**Y**	**Y**	**Visible**	**N**	**Y**	**N**	**Light grey with scattered small, indistinct greenish dots**
A. adicola	44.0–47.0	62.0–72.0	HL>HW	Y	Y	Visible	Y	Y	N	Reddish brown
A. akhaorum	34.9–37.2	58.8–62.5	HL>HW	Y	Y	Visible	Y	Y	N	Green with distinct brown mottling
A. aniqiaoensis	?	52.0	?	Y	Y	Invisible	Y	Y	N	Olive green or brown
A. archotaphus	38.2– 42.1	58.8–62.5	HL<HW or HL>HW	Y	Weak or N	Visible	Y	Y	Y	Olive green or brown, with irregularly distributed small brown spots
A. bellulus	45.9–50.1	63.6	HL>HW	N	Y	Visible	N	Y	N	Olive green with brown spots
A. chakrataensis	?	55.0	HL<HW	?	Y	Visible	?	Y	N	Reddish brown
A. chunganensis	34.0–39.0	44.0–54.0	HL>HW	Y	Y	Visible	Y	Y	N	Reddish brown
A. compotrix	31.4–42.6	55.6–56.9	HL>HW	Y	Y	Visible	Y	Y	Y	Bluish green
A. cucae	40.7–44.6	65.8–68.0	HL>HW	Y	Y	Visible	Y	Y	Y	Light green
A. daorum	32.0–38.1	53.3–57.6	HL>HW	Y	Y	Visible	Y	N	N	Green with black spots
A. deng	50.3–57.6	68.5–72.0	HL=HW	?	Y	Visible	Y	Y	N	Brown
A. gerbillus	66.0	?	HL>HW	?	Y	Invisible	?	Y	N	Reddish brown
A. iriodes	39.0–43.0	63.0	HL>HW	Y	Y	Visible	Y	Y	N	Iridescent green
A. kohimaensis	42.8–48.6	?	HL>HW	Y	Y	Visible	Weak	Y	N	Brown
A. mengdingensis	36.9–40.2	64.3	HL>HW	Y	Y	Visible	Y	Y	N	Green
A. mengyangensis	38.3–38.7	60.0	HL>HW	Y	Y	Visible	Y	N	N	Olive brown
A. monticola	41.0	65.0–75.0	HL=HW	Y	N	Visible	Y	Y	N	Reddish brown/brownish green
A. nyingchiensis	48.5–58.3	57.6–70.7	HL>HW	N	Y	Visible	Y	Y	N	Light brown
A. putaoensis	37.6–40.2	?	HL<HW	Y	Y	Visible	Y	Y	N	Brown with dark spots
A. tuanjieensis	39.5–40.4	56.8–60.7	HL>HW	Y	Y	Visible	Y	Y	N	Reddish brown
A. vitreus	37.5–43.6	?	HL>HW	Y	Y	Visible	Y	Y	Y	Green
A. wenshanensis	35.7–39.9	43.7–45.6	HL>HW	Y	Y	Visible	Y	Y	N	Green

Table 4. Morphological comparisons between *Amolops truongi,* new species, with *A. compotrix* (Bain et al., 2006).

	***Amolops truongi*, new species,**				***A. compotrix***			
	Males (n = 7)		**Females (n = 3)**		**Males (n = 10)**		**Females (n = 3)**	
	Min–Max	**Mean ± SD**	**Min–Max**	**Mean ± SD**	**Min–Max**	**Mean ± SD**	**Min–Max**	**Mean ± SD**
SVL	37.5–41.3	39.5±1.5	61.5–62.5	62.1±0.55	31.4–42.6	36.8±3.1	55.6–56.9	56.4±0.7
HL	13.4–15	14.1±0.6	21.5–22.5	21.9±0.55	12.3–14.6	13.6±0.8	19.0–20.1	19.4±0.6
HW	12–13.8	12.9±0.7	20–20.5	20.2±0.29	10.1–13.3	11.6±1.0	16.8–18.2	17.5±0.7
SE	6.1–6.7	6.4±0.2	9.2–9.3	9.2±0.06	4.9–5.9	5.4±0.3	7.7–8.2	7.9±0.3
IOD	3.2–3.7	3.5±0.2	4.7–5.1	4.9±0.21	3.2–4.2	3.6±0.3	5.4–6.0	5.6±0.4
ED	5.3–6	5.7±0.3	8–8.1	8.1±0.06	4.5–5.6	4.9±0.4	6.8–7.1	6.9±0.2
TD	2.0–2.2	2.1±0.1	2.9–3.0	3±0.06	1.8–2.6	2.3±0.2	2.9–3.1	3.0±0.1
TED	1.2–1.6	1.4±0.1	2.5–2.7	2.6±0.1	1.0–1.7	1.3±0.2	1.8–2.1	2.0±0.1
FL	18.8–21.5	20±1.1	30–32.7	31.6±1.4	15.2–22.9	18.4±2.7	26.7–29.1	28.2±1.4
TL	23.3–25.7	24.5±0.8	37.2–38	37.7±0.42	17.9–24.3	22.3±1.6	31.9–35.2	33.4±1.6
FOT	30.1–34.6	32.1±1.7	48.6–50.2	49.2±0.85	14.7–23.7	18.7±2.6	26.9–28.9	27.8±1.0
	Min–Max	**Median**	**Min–Max**	**Median**	**Min–Max**	**Median**	**Min–Max**	**Median**
HL/HW	1.05–1.13	1.09	1.05–1.13	1.08	1.08–1.29	1.17	1.09–1.14	1.1
SE/HL	0.45–0.46	0.45	0.41–0.43	0.42	0.36–0.45	0.40	0.40–0.41	0.41
TD/ED	0.37–0.37	0.37	0.36–0.37	0.37	0.41–0.51	0.47	0.41–0.45	0.44
ED/SE	0.85–0.9	0.89	0.87–0.88	0.87	0.79–1.04	0.92	0.84–0.91	0.88
TL/SVL	0.6–0.62	0.62	0.6–0.62	0.61	0.56–0.66	0.61	0.57–0.62	0.58
Tympanum of males vs. females	Males small compared to females				Males equal or near equal compared to females			
Groove on disc of first finger	Absent				Present			
Outer metatarsal tubercle (Hindlimbs)	Absent				Present			
Dorsal colour in life	Light grey with scattered small, indistinct greenish dots				Bluish green			

namely Khammouane Province in Lao PDR and Thua Thien Hue and Kon Tum provinces in Vietnam, where the species is found (Bain et al., 2006). In terms of morphology, the population in Son La only superficially resembles *A. compotrix*, i.e., similarity in body colourations and HL/HW and TD/ED ratios, but the two taxa differ in female size and SL/HL and ED/SL ratios. Moreover, samples of the population have not been sequenced for comparison with other species in the group. Thus, the population from Son La Province, which may represent a new taxon of *Amolops*, requires further morphological and molecular analyses to confirm its taxonomic status.

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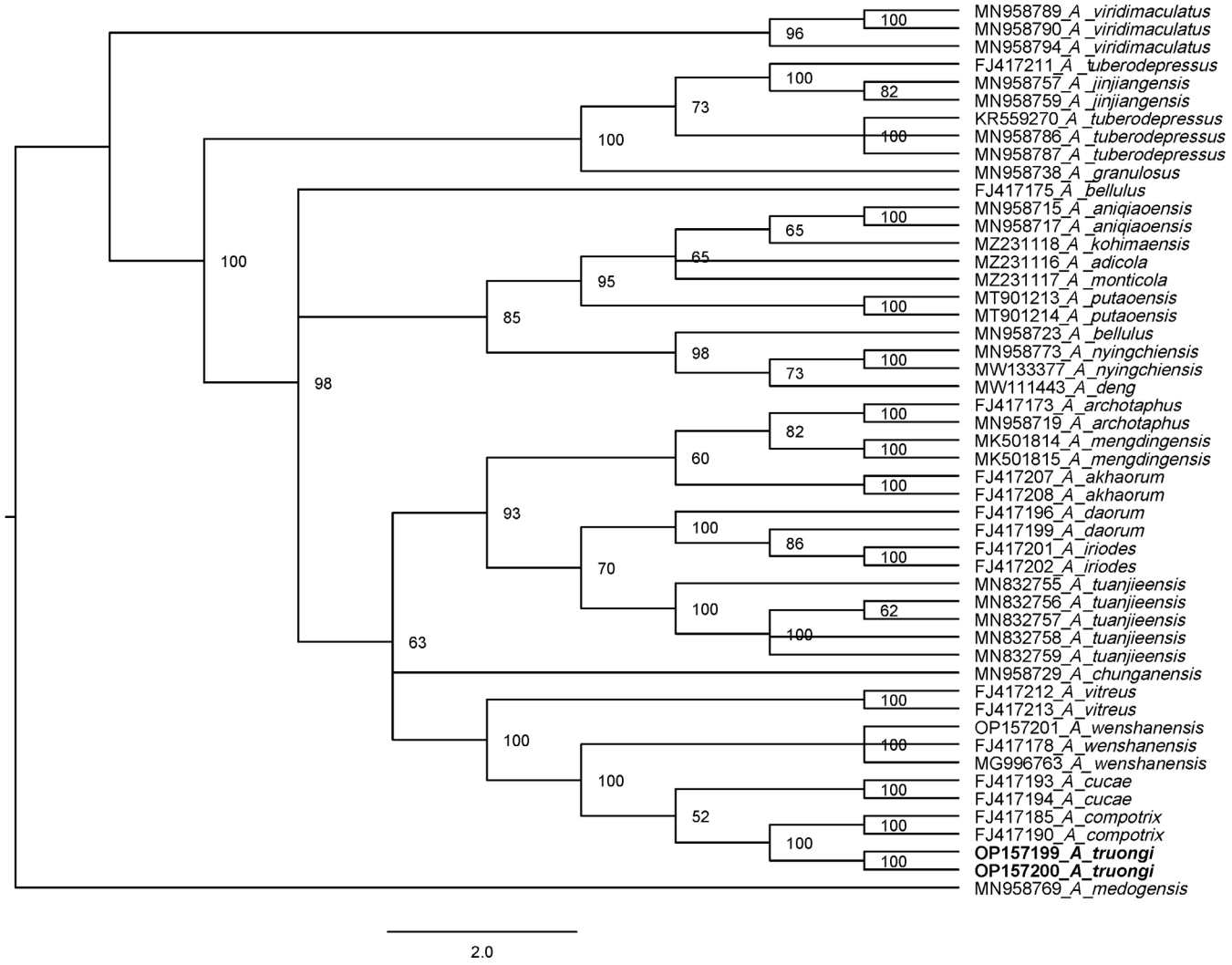
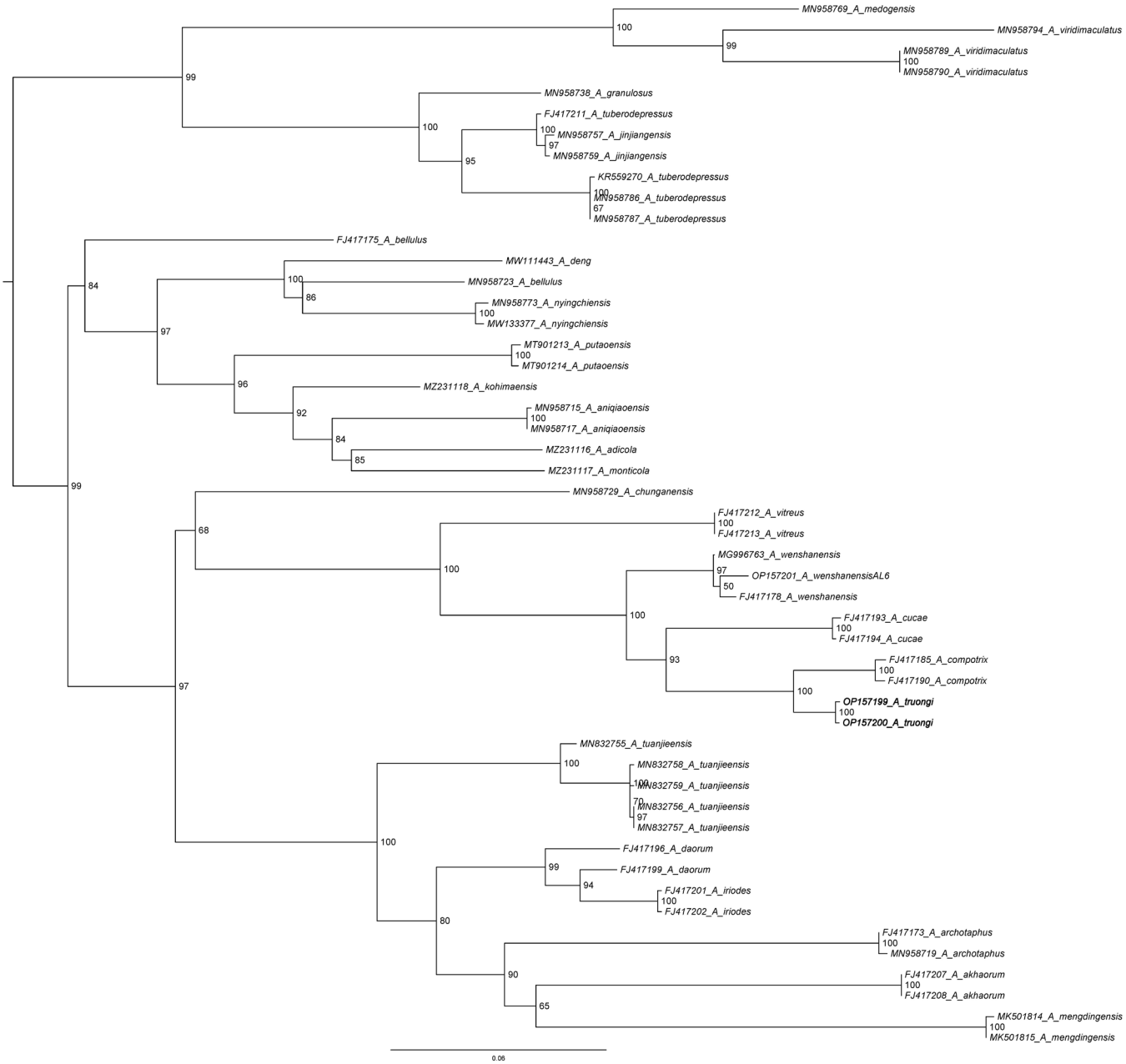
APPENDIX

Appendix 1. List of comparative specimens examined.

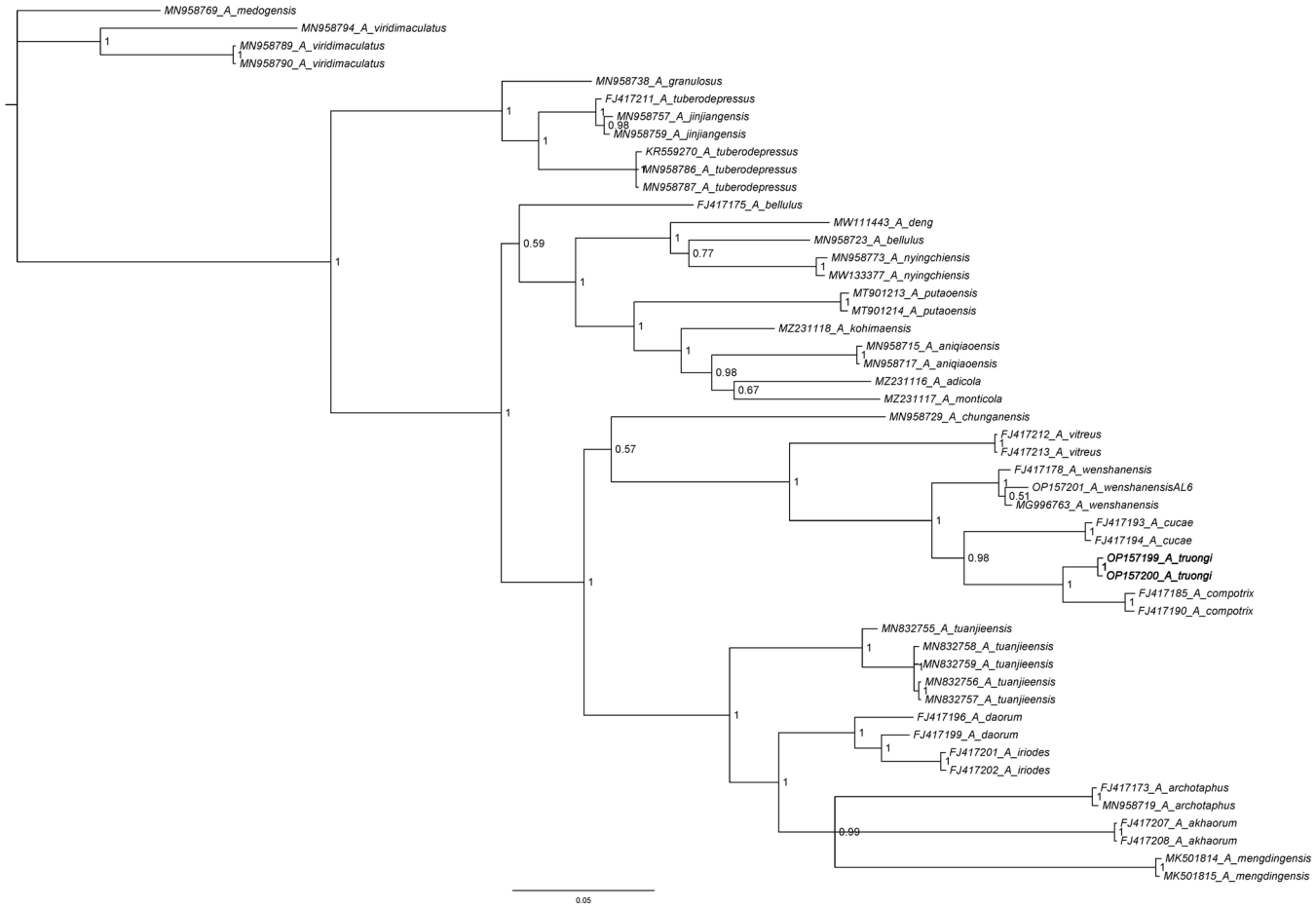
Species	No. of samples	Locality	Field Number
A. cremnobatus	6	Vietnam: Thanh Hoa Province: Pu Hu Nature Reserve:	IEBR A.2013.106, A.2013.107
		Thanh Hoa Province: Xuan Lien Nature Reserve	IEBR 4353–4356
A. iriodes	4	Vietnam: Lao Cai Province: Bat Xat District	IEBR 4357–4360
A. ottorum	2	Vietnam: Son La Province: Muong La District	IEBR 4342, TBU 06
A. ricketti	8	Vietnam: Cao Bang Province: Phia Oac-Phia Den National Park	IEBR 4361–4364
		Vietnam: Quang Ninh Province: Hai Ha District	IEBR 4365, 4366
		Vietnam: Bac Giang Province: Tay Yen Tu Nature Reserve	IEBR 4367, 4368
A. spinapectoralis	5	Vietnam: Thua Thien Hue Province: A Luoi District	IEBR 4264–4266
		Vietnam: Gia Lai Province: Kon Ka Kinh National Park	IEBR 4369, 4370
A. vitreus	8	Vietnam: Son La Province: Copia Nature Reserve	TBU PAE.153, 154, 295, 296, 298, 361, 362, 517



Appendix 2. Maximum parsimony tree. Numbers at nodes are bootstrap values generated from 1,000 pseudo-replicates. MP analysis found 417 characters parsimony informative and produced 12 most parsimonious trees (Tree length = 1,554, Consistency index = 0.4, Retention index = 0.77).



Appendix 3. Maximum likehood tree. Numbers at nodes are ultrafast bootstrap values generated from 10,000 replicates.



Appendix 4. Single-model Bayesian tree. Numbers at nodes are posterior probabilities.