

## A new species of *Amolops* (Anura: Ranidae) from Bach Ma National Park, Central Vietnam

CUONG THE PHAM<sup>1,2,\*</sup>, LOI DUC DUONG<sup>3</sup>, CHUNG VAN HOANG<sup>1</sup>, PHUONG HUY DANG<sup>1</sup>, HAI NGOC NGO<sup>1,4,5</sup>, THOMAS ZIEGLER<sup>6,7</sup> & TRUONG QUANG NGUYEN<sup>1,2,\*</sup>

<sup>1</sup>Institute of Biology, Vietnam Academy of Science and Technology, 18 Hoang Quoc Viet Road, Hanoi 10072, Vietnam

 [cuongiebr@gmail.com](mailto:cuongiebr@gmail.com);  <https://orcid.org/0000-0001-5158-4526>

 [chungiebr@gmail.com](mailto:chungiebr@gmail.com);  <https://orcid.org/0000-0002-0709-974X>

 [phuongiebr@gmail.com](mailto:phuongiebr@gmail.com);  <https://orcid.org/0000-0002-2323-9511>

<sup>2</sup>Graduate University of Science and Technology, Vietnam Academy of Science and Technology, 18 Hoang Quoc Viet Road, Hanoi 10072, Vietnam

 [nqt2@yahoo.com](mailto:nqt2@yahoo.com);  <https://orcid.org/0000-0002-6601-0880>

<sup>3</sup>University of Education, Hue University, 34 Le Loi Road, Thuan Hoa Ward, Hue City, Vietnam

 [duongducloi@hueuni.edu.vn](mailto:duongducloi@hueuni.edu.vn);  <https://orcid.org/0009-0008-0835-5574>

<sup>4</sup>Institute of Theoretical and Applied Research, Duy Tan University, 100000 Hanoi, Vietnam;

 [ngongochai1@duytan.edu.vn](mailto:ngongochai1@duytan.edu.vn);  <https://orcid.org/0000-0002-5925-7797>

<sup>5</sup>School of Medicine and Pharmacy, Duy Tan University, 550000 Da Nang, Vietnam

<sup>6</sup>Cologne Zoo, Riehler Straße 173, 50735, Cologne, Germany

 [ziegler@koelnerzoo.de](mailto:ziegler@koelnerzoo.de);  <https://orcid.org/0000-0002-4797-609X>

<sup>7</sup>Institute of Zoology, University of Cologne, Zùlpicher Straße 47b, 50674, Cologne, Germany

\*Corresponding authors

### Abstract

A new species of *Amolops* is described from the evergreen forest of Bach Ma National Park, Central Vietnam based on morphological differences and molecular divergence. Morphologically, *Amolops orlovi* **sp. nov.** is distinguishable from its congeners by the following combination of characteristics: size medium (SVL 40.2–44.3 mm in males, 46.3–53.8 mm in females); head slightly longer than wide; tympanum visible, round, about 30% the diameter of eye; vomerine teeth present; males with external vocal sac; nuptial pad on the first finger prominent with whitish conical spines in males; toes fully webbed; tibio-tarsal articulation reaching the tip of nostril when hindlimb adpressed along body; dorsolateral fold absent; males with an oval group of similar sized spines on each side on chest; dorsum olive-brown with irregular light yellow strip-shaped patches; and ventral surface cream. Phylogenetic analyses based on mitochondrial 16S rRNA and COI gene sequences supported the new species as a sister taxon to *A. spinaepectoralis*. The uncorrected p-distances between the new species and its closest congeners, were 5.93% for the 16 rRNA and 5.95% for the COI gene.

**Key words:** *Amolops orlovi* **sp. nov.**, evergreen forest, molecular phylogeny, taxonomy

### Introduction

The genus *Amolops* Cope, 1865 has a wide distribution in Asia, from Nepal and northern India eastwards to China and southwards to Malaysia (Frost 2026). The genus belongs to one of the most diverse groups of amphibians with 92 recognized species, and more than 20 new species having been described in the last five years (Frost 2026). Recent studies assigned all members of this genus into ten species groups, namely the *Amolops chayuensis* group, *A. daiyunensis* group, *A. hainanensis* group, *A. laurentis* group, *A. mantzorum* group, *A. marmoratus* group, *A. monticola* group, *A. ricketti* group, *A. spinaepectoralis* group, and *A. viridimaculatus* group (Jiang *et al.* 2021; Liu *et al.* 2025).

In Vietnam, a total of 19 *Amolops* species have been documented and additional new species of the genus is likely to be discovered in the future (Frost 2026). During the last five years, four new species were discovered

## Discussion

In this study, the population of *Amolops* from Bach Ma NP, Hue City, located north of Hai Van Pass, is herein recognized as a new species, namely *Amolops orlovi* (Fig. 7). The discovery brings the total number of known species in the genus to 93 and the species known from Vietnam to 20 (Pham *et al.* 2026; Frost 2026). It is noteworthy that the sister species of *A. spinaepectoralis* has been recorded from Da Nang City southwards to Dak Lak Province, south of Hai Van Pass (Fig. 7). In particular, *Amolops spinaepectoralis* sensu stricto was originally described from Kon Chu Rang NR, Gia Lai Province, Central Highlands Vietnam (Inger *et al.* 1999), and extensively recorded in Quang Ngai and Dak Lak provinces, as well as in Da Nang and Hue cities of Vietnam and Xekong Province of Laos (Do *et al.* 2017; Duong *et al.* 2025; Frost 2026). However, the records of *Amolops spinaepectoralis* in Xekong Province, Laos, and Dak Lak Province, Vietnam, are based on morphological data only, and therefore require further verification using genetic data to ensure accurate species identification.

These findings suggest that Hai Van Pass might represent a natural geographic barrier, likely associated with climatic gradients between the two regions, promoting the lineage divergence between the two species, as reported in previous studies (Sterling *et al.* 2006; Bain & Hurley 2011; Pham *et al.* 2018; Blair *et al.* 2023). However, further studies across diverse taxonomic groups are required to confirm this hypothesis.

Concerning conservation status assessment, *Amolops orlovi* is only known from a restricted range in Bach Ma NP, with less than 2,000 km<sup>2</sup> estimated extent of occurrence, and inhabiting areas undergoing severe forest degradation. At the moment, the actual impact of these threats on the new species is not yet well understood. In this study, we recommend listing the species as Data Deficient based on the IUCN Red List categories and criteria (IUCN 2026). Further research is needed to assess the population status of this species and to determine anthropogenic threats. The description of *Amolops orlovi* further highlights the significance of the Bach Ma NP as an area of outstanding herpetofauna diversity.

## Acknowledgements

We are grateful to the directorates of the Bach Ma and Kon Ka Kinh national parks; Kon Chu Rang and Ngoc Linh nature reserves; Elephant Habitat and Species Conservation Area; Nam Giang Watershed Protection Forest Management Board; Forest Protection Department of Gia Lai, Quang Ngai provinces and Da Nang, Hue cities for support of our field work. We thank A.M. Luong, T.Q. Phan (IB, Hanoi) and H.D. Van, T.H. Nguyen (Hue) for their assistance in the field; M.H.T. Nguyen and T.P.T. Bui (IB, Hanoi) for their support in the laboratory. For the fruitful cooperation within joint research projects, we cordially thank T.Q. Phi and A.H. Le (IB, Hanoi) as well as T. Pagel and C. Landsberg (Cologne Zoo). We would like to thank the editor, Bryan L. Stuart, and another anonymous reviewer for their valuable comments on the manuscript. Field surveys in Vietnam were partially supported by Cologne Zoo. This research was supported by the Vietnam Academy of Science and Technology (Project Code: VAST04.10/26-27).

## References

- Bain, R.H. & Hurley, M.M. (2011) A biogeographic synthesis of the amphibians and reptiles of Indochina. *Bulletin of the American Museum of Natural History*, 360, 1–138.  
<https://doi.org/10.1206/360.1>
- Bain, R.H., Lathrop, A., Murphy, R.W., Orlov, N.L. & Ho, C.T. (2003) Cryptic species of a cascade frog from Southeast Asia: taxonomic revisions and descriptions of six new species. *American Museum Novitates*, 3417, 1–60.  
[https://doi.org/10.1206/0003-0082\(2003\)417<0001:csoacf>2.0.co;2](https://doi.org/10.1206/0003-0082(2003)417<0001:csoacf>2.0.co;2)
- Beaupre, S.J., Jacobson, E.R., Lillywhite, H.B. & Zamudio, K. (2004) *Guidelines for use of live amphibians and reptiles in field and laboratory research*. The Herpetological Animal Care and Use Committee (HACC), American Society of Ichthyologists and Herpetologists, Miami, Florida, 43 pp.
- Blair, M.E., Cao, G.T.H., López-Nandam, E.H., Veronese-Paniagua, D.A., Birchette, M.G., Kenyon, M., Md-Zain, B.M., Munds, R.A., Nekar, K.A.-I., Nijman, V., Roos, C., Thach, H.M., Sterling, E.J. & Le, M.D. (2023) Molecular phylogenetic relationships and unveiling novel genetic diversity among slow and pygmy lorises, including resurrection of *Xanthonycticebus intermedius*. *Genes*, 14, 643.  
<https://doi.org/10.3390/genes14030643>

- Boulenger, G.A. (1899) On a collection of reptiles and batrachians made by Mr. J. D. Latouche in N.W. Fokien, China. *Proceedings of the Zoological Society of London*, 1899, 159–172.  
<https://doi.org/10.1111/j.1469-7998.1899.tb06855.x>
- Chan, K.O. & Grismer, L.L. (2022) GroupStruct: An R package for allometric size correction. *Zootaxa*, 5124 (4), 471–482.  
<https://doi.org/10.11646/zootaxa.5124.4.4>
- Che, J., Chen, H.M., Yang, J.X., Jin, J.Q., Jiang, K., Yuan, Z.Y., Murphy, R.W. & Zhang, Y.P. (2012) Universal COI primers for DNA barcoding amphibians. *Molecular Ecology Resources*, 12, 247–258.  
<https://doi.org/10.1111/j.1755-0998.2011.03090.x>
- Cope, E.D. (1865) Sketch of the primary groups of Batrachia s. Salientia. *Natural History Review*, 5, 97–120.
- Darriba, D., Taboada, G.L., Doallo, R. & Posada, D. (2012) jModelTest 2: More models, new heuristics and high-performance computing. *Nature Methods*, 9, e772.  
<https://doi.org/10.1038/nmeth.2109>
- Do, D.T., Ngo, C.D. & Nguyen, T.Q. (2017) New records and an updated checklist of amphibians (Amphibia) from Phu Yen Province, Vietnam. *Hue University Journal of Science: Natural Science*, 126, 81–94.  
<https://doi.org/10.26459/hueuni-jns.v126i1B.4073>
- Duong, L.D., Tran, G.V. & Hoang, N.T. (2025) Morphometry and feeding notes of an endemic frog *Amolops spinapectoralis* (Amphibia: Ranidae) from Hue City, central Vietnam. *Journal of Threatened Taxa*, 17, 28011–28015.  
<https://doi.org/10.11609/jott.10064.17.12.28011-28025>
- Fei, L., Hu, S., Ye, C. & Huang, Y. (2009) *Fauna Sinica. Amphibia. Volume 3. Anura*. Science Press, Beijing, 887 pp.
- Fei, L., Ye, C.Y. & Jiang, J.P. (2012) *Colored atlas of Chinese amphibians and their distributions*. Sichuan Publishing House of Science & Technology, Sichuan, 619 pp.
- Frost, D.R. (2026) *Amphibian Species of the World: an online reference*. Version 6.2. American Museum of Natural History, New York. Available from: <http://research.amnh.org/vz/herpetology/amphibia/> (accessed 10 April 2026)
- Glaw, F. & Vences, M. (2007) *A field guide to the amphibians and reptiles of Madagascar. 3<sup>rd</sup> Edition*. FroschVerlag, Cologne, 496 pp.
- Günther, A. (1875) Third report on collections of Indian reptiles obtained by the British Museum. *Proceedings of the Zoological Society of London*, 1875, 567–577.
- Hoang, D.T., Chernomor, O., von Haeseler, A., Minh, B.Q. & Vinh, L.S. (2018) UFBoot2: Improving the ultrafast bootstrap approximation. *Molecular Biology and Evolution*, 35 (2), 518–522.  
<https://doi.org/10.1093/molbev/msx281>
- Inger, R.F., Orlov, N.L. & Darevsky, I.S. (1999) Frogs of Vietnam: a report on new collections. *Fieldiana Zoology*, New Series, 92, 1–46.  
<https://doi.org/10.5962/bhl.title.3478>
- IUCN (2026) The IUCN Red List of Threatened Species. Version 2025-1. Available from: <https://www.iucnredlist.org> (accessed 28 March 2026)
- Jiang, K., Ren, J.L., Lyu, Z.T., Wang, D., Wang, Z., Lv, K., Wu, J.W. & Li, J.T. (2021) Taxonomic revision of *Amolops chunganensis* (Pope, 1929) (Amphibia: Anura) and description of a new species from southwestern China, with discussion on species groups of the genus *Amolops*. *Zoological Research*, 42 (5), 574–591.  
<https://doi.org/10.24272/j.issn.2095-8137.2021.107>
- Kassambara, A. & Mundt, F. (2020) Factoextra: extract and visualize the results of multivariate data analyses. R package, version 1.0.7. Available from: <https://CRAN.R-project.org/package=factoextra> (accessed 1 December 2025)
- Le, S., Josse, J. & Husson, F. (2008) FactoMineR: a package for multivariate analysis. *Journal of Statistical Software*, 25, 1–18.  
<https://doi.org/10.18637/jss.v025.i01>
- Li, S.Z., Liu, J., Ke, X.C., Cheng, G. & Wang, B. (2024) A new species of *Amolops* (Amphibia, Anura, Ranidae) from Guizhou Province, China. *ZooKeys*, 1189, 33–54.  
<https://doi.org/10.3897/zookeys.1189.115621>
- Liu, S., Hou, M., Mo, M., Lu, Y., Guo, J., Wang, W., Zhang, W. & Rao, D. (2025) A new species of the *Amolops monticola* group (Anura, Ranidae) from southern Yunnan, China. *Journal of Asia-Pacific Biodiversity*, 18, 258–268.  
<https://doi.org/10.1016/j.japb.2024.08.002>
- Liu, C. & Hu, S. (1975) Report on three new species of Amphibia from Fujian Province. *Acta Zoologica Sinica*, 21, 265–271.
- Lleonart, J., Salat, J. & Torres, G.J. (2000) Removing allometric effects of body size in morphological analysis. *Journal of Theoretical Biology*, 205, 85–93.  
<https://doi.org/10.1006/jtbi.2000.2043>
- Lyu, Z.T., Wu, J., Wang, J., Sung, Y.H., Liu, Z.Y., Zeng, Z.C., Wang, X., Li, Y.Y. & Wang, Y.Y. (2018) A new species of *Amolops* (Anura, Ranidae) from southwestern Guangdong, China. *Zootaxa*, 4418 (6), 562–576.  
<https://doi.org/10.11646/zootaxa.4418.6.4>
- Lyu, Z.T., Huang, L.S., Wang, J., Li, Y.Q., Chen, H.H., Qi, S. & Wang, Y.Y. (2019) Description of two cryptic species of the *Amolops ricketti* group (Anura, Ranidae) from southeastern China. *ZooKeys*, 812, 133–156.  
<https://doi.org/10.3897/zookeys.812.29956>
- Nguyen, L.T., Schmidt, H.A., von Haeseler, A. & Minh, B.Q. (2015) IQ-TREE: a fast and effective stochastic algorithm for

- estimating maximum-likelihood phylogenies. *Molecular Biology and Evolution*, 32 (1), 268–274.  
<https://doi.org/10.1093/molbev/msu300>
- Nguyen, L.T., Tapley, B., La, T.V. & Rowley, J.J.L. (2025) A new species of the *Amolops monticola* group (Amphibia, Anura, Ranidae) from the Hoang Lien Range, Vietnam. *Zootaxa*, 5594 (3), 485–508.  
<https://doi.org/10.11646/zootaxa.5594.3.3>
- Oksanen, J., Blanchet, F.G., Friendly, M., Kindt, R., Legendre, P., McGlinn, D., Minchin, P.R., O'Hara, R.B., Simpson, G.L., Sölymos, P., Stevens, M.H.H., Szoecs, E. & Wagner, H. (2020) vegan: community ecology package. Available from: <https://CRAN.R-project.org/package=vegan> (accessed 1 December 2025)
- Pham, A.V., Hoang, C.V., Nguyen, T.Q., Nguyen, V.H.T., Nguyen, T.T.T., Nguyen, K.D., Thai, T.C., Hoang, N.V. & Pham, C.T. (2026) A new species of *Amolops* (Anura, Ranidae) from Vu Quang National Park, Vietnam. *Zootaxa*, 5760 (2), 225–247.  
<https://doi.org/10.11646/zootaxa.5760.2.4>
- Pham, A.V., Hoang, C.V., Tapley, B., Nguyen, L.T., Nguyen, H.H., La, T.V., Ziegler, T., Rowley, J.J.L., Nguyen, T.Q. & Le, M.D. (2025) *Amolops cuongi* (Amphibia, Anura, Ranidae), a new species from the Hoang Lien Range, Vietnam. *ZooKeys*, 1256, 235–257.  
<https://doi.org/10.3897/zookeys.1256.158846>
- Pham, C.T., Le, M.D., Hoang, C.V., Pham, A.V., Ziegler, T. & Nguyen, T.Q. (2020) First records of *Bufo luchunnicus* and *Amolops wenshanensis* from Vietnam. *Russian Journal of Herpetology*, 27, 81–86.  
<https://doi.org/10.30906/1026-2296-2020-27-2-81-86>
- Pham, C.T., Le, M.D., Ngo, H.T., Ziegler, T. & Nguyen, T.Q. (2018) A new species of *Limnonectes* (Amphibia: Anura: Dicroglossidae) from Vietnam. *Zootaxa*, 4508 (1), 115–130.  
<https://doi.org/10.11646/zootaxa.4508.1.7>
- Pham, A.V., Pham, C.T., Ngo, H.T., Sung, N.B., Ziegler, T. & Le, M.D. (2023) A new species of *Amolops* (Anura, Ranidae) from Son La Province, northwestern Vietnam. *Raffles Bulletin of Zoology*, 71, 59–69.  
<https://doi.org/10.26107/RBZ-2023-0004>
- R Core Team (2025) R: a language and environment for statistical computing. R Foundation for Statistical Computing, Vienna. Available from: <http://www.R-project.org> (accessed 25 November 2025)
- Rambaut, A., Drummond, A.J., Xie, D., Baele, G. & Suchard, M.A. (2018) Posterior summarisation in Bayesian phylogenetics using Tracer 1.7. *Systematic Biology*, 67, 901–904.  
<https://doi.org/10.1093/sysbio/syy032>
- Ronquist, F., Teslenko, M., van der Mark, P., Ayres, D.L., Darling, A., Höhna, S., Larget, B., Liu, L., Suchard, M.A. & Huelsenbeck, J.P. (2012) MrBayes 3.2: efficient Bayesian phylogenetic inference and model choice across a large model space. *Systematic Biology*, 61 (3), 539–542.  
<https://doi.org/10.1093/sysbio/sys029>
- Simmons, J.E. (2002) *Herpetological collecting and collections management*. *Herpetological Circular No. 31*. Society for the Study of Amphibians and Reptiles, East Lansing, Michigan, 153 pp.
- Sheridan, J.A., Phimmachak, S., Sivongxay, N. & Stuart, B.L. (2023) Systematics of the Lao torrent frog, *Amolops cremnobatus* Inger & Kottelat, 1998 (Anura: Ranidae), with descriptions of four new species. *Vertebrate Zoology*, 73, 931–956.  
<https://doi.org/10.3897/vz.73.e102475>
- Simon, C., Frati, F., Beckenbach, A., Crespi, B., Liu, H. & Flook, P. (1994) Evolution, weighting, and phylogenetic utility of mitochondrial gene sequences and a compilation of conserved polymerase chain reaction primers. *Annals of the Entomological Society of America*, 87 (6), 651–701.  
<https://doi.org/10.1093/aesa/87.6.651>
- Song, H.M., Qi, S., Wang, H.T., Gong, Y., Liu, Y. & Wang, Y.Y. (2025) Definition and taxonomic revision of the karst-associated *Odorrana lipuensis* group (Anura, Ranidae), with a new species from Guangdong, China. *Zoosystematics and Evolution*, 101, 935–952.  
<https://doi.org/10.3897/zse.101.142746>
- Sterling, E.J., Hurley, M.M. & Le, D.M. (2006) *Vietnam: A Natural History*. Yale University Press, New Haven, Connecticut, 423 pp.
- Sung, Y., Hu, P., Wang, J., Liu, H. & Wang, Y.Y. (2016) A new species of *Amolops* (Anura: Ranidae) from southern China. *Zootaxa*, 4170 (3), 525–538.  
<https://doi.org/10.11646/zootaxa.4170.3.6>
- Tamura, K., Stecher, G. & Kumar, S. (2021) MEGA11: molecular evolutionary genetics analysis version 11. *Molecular Biology and Evolution*, 38 (7), 3022–3027.  
<https://doi.org/10.1093/molbev/msab120>
- Tanabe, A.S. (2011) Kakusan4 and Aminosan: two programs for comparing nonpartitioned, proportional and separate models for combined molecular phylogenetic analyses of multilocus sequence data. *Molecular Ecology Resources*, 11, 914–921.  
<https://doi.org/10.1111/j.1755-0998.2011.03021.x>
- Thompson, J.D., Gibson, T.J., Plewniak, F., Jeanmougin, F. & Higgins, D.G. (1997) The ClustalX windows interface: flexible strategies for multiple sequence alignment aided by quality analysis tools. *Nucleic Acids Research*, 25, 4876–4882.  
<https://doi.org/10.1093/nar/25.24.4876>
- Thorpe, R.S. (1975) Quantitative handling of characters useful in snake systematics with particular reference to interspecific

- variation in the ringed snake *Natrix natrix* (L.). *Biological Journal of the Linnean Society*, 7, 27–43.  
<https://doi.org/10.1111/j.1095-8312.1975.tb00732.x>
- Thorpe, R.S. (1983) A review of the numerical methods for recognizing and analyzing racial differentiation. In: Felsenstein, J. (Ed.), *Numerical taxonomy*. Springer, Berlin, pp. 404–423.  
[https://doi.org/10.1007/978-3-642-69024-2\\_43](https://doi.org/10.1007/978-3-642-69024-2_43)
- Turan, C. (1999) A note on the examination of morphometric differentiation among fish populations: the truss system. *Turkish Journal of Zoology*, 23, 259–263.
- Wang, J., Li, J., Du, L., Hou, M. & Yu, G. (2022) A cryptic species of the *Amolops ricketti* species group (Anura, Ranidae) from China–Vietnam border regions. *ZooKeys*, 1112, 139–159.  
<https://doi.org/10.3897/zookeys.1112.82551>
- Wu, Y., Yan, F., Stuart, B.L., Prendini, E., Suwannapoom, C., Dahn, H.A., Zhang, B., Cai, H., Xu, Y., Jiang, K., Chen, H., Lemmon, A.R., Lemmon, E.M., Raxworthy, C.J., Orlov, N.L., Murphy, R.W. & Che, J. (2020) A combined approach of mitochondrial DNA and anchored nuclear phylogenomics sheds light on unrecognized diversity, phylogeny, and historical biogeography of the torrent frogs, genus *Amolops* (Anura: Ranidae). *Molecular Phylogenetics and Evolution*, 148, 106789.  
<https://doi.org/10.1016/j.ympev.2020.106789>
- Yuan, Z.Y., Jin, J.Q., Li, J.N., Stuart, B.L. & Wu, J. (2018) A new species of cascade frog (Amphibia: Ranidae) in the *Amolops monticola* group from China. *Zootaxa*, 4415 (3), 498–512.  
<https://doi.org/10.11646/zootaxa.4415.3.5>