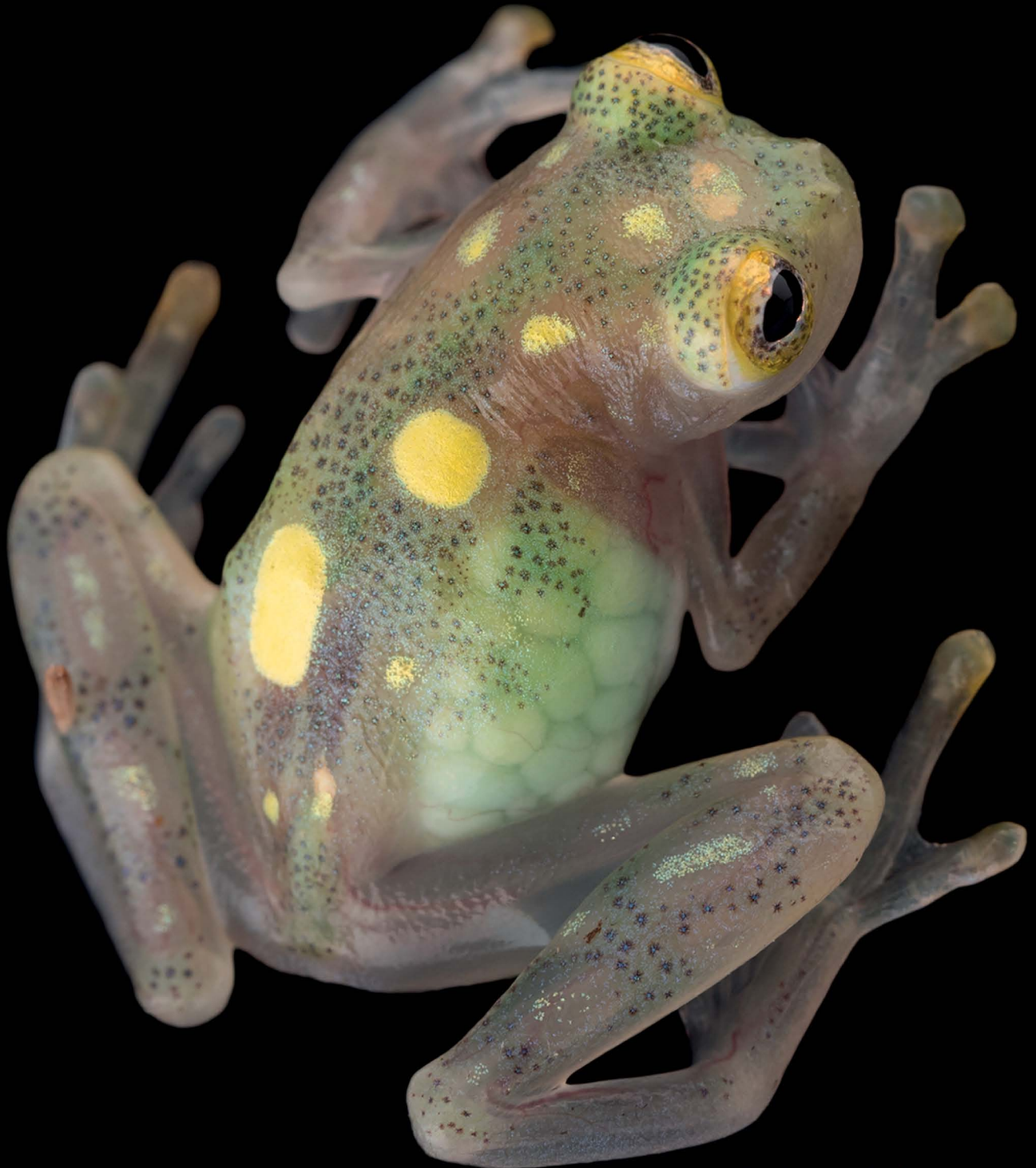


Amphibians of Ecuador

Phyllomedusidae, Leptodactylidae, Ceratophryidae,
Hemiphractidae, Eleutherodactylidae, Centrolenidae,
Gymnophiona, and Caudata, Volume IV



Amphibians of Ecuador

Amphibians of Ecuador: Phyllomedusidae, Leptodactylidae, Ceratophryidae, Hemiphractidae, Eleutherodactylidae, Centrolenidae, Gymnophiona, and Caudata, Volume IV is the final installment in a four-volume series that provides comprehensive, well-illustrated, and authoritative insights into the amphibian species of Ecuador, making it an invaluable resource for biologists, conservationists, and others. The series explores, in comprehensive detail, the cultural history and the rich amphibian diversity of Ecuador, providing a thorough review of biogeography, amphibian declines, and conservation.

Volume IV specifically focuses on Phyllomedusidae, Leptodactylidae, Ceratophryidae, Hemiphractidae, Eleutherodactylidae, Centrolenidae, Gymnophiona, and Caudata. Characteristics of each species are listed, defined, and compared to similar other species. Reproductive behavior, where known, is described, as are data on vocalizations, larvae, and ontogenetic changes. Amphibian distributions are detailed and illustrated with physiographic maps with dots. This volume also addresses the declines, extinctions, and conservation status of each species, highlighting their occurrence in protected areas.

KEY FEATURES:

- Provides detailed and comprehensive accounts for all species from Ecuador of Phyllomedusidae, Leptodactylidae, Ceratophryidae, Hemiphractidae, Eleutherodactylidae, Centrolenidae, Gymnophiona, and Caudata. An Addendum includes accounts of 20 species described from 2023 to January 2025.
- New data are incorporated for many species.
- Describes with full color maps the distribution of all known taxa.
- Includes information on the ecology, reproduction, and behavior of all taxa.



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Gymnophiona, and Caudata

Volume IV

Luis A. Coloma and William E. Duellman



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Designed front cover image: Cover. Female of the gold-spotted glassfrog *Hyalinobatrachium aureoguttatum* with the green oocytes and other organs visible through its skin at Wikiri Sapoparque in Quito, Ecuador. Photo by Luis A. Coloma.

Back Cover. Male of the gold-spotted glassfrog *Hyalinobatrachium aureoguttatum* taking care of two clutches of eggs at Wikiri Sapoparque in Quito, Ecuador. Photo by Luis A. Coloma.

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About the Authors

Luis A. Coloma

Coloma is an amphibian biologist who was born in Guaranda, Provincia Bolívar, Ecuador, in 1962. He received his *licenciatura* in biological sciences from Pontificia Universidad Católica del Ecuador (PUCE) in 1987. In 1991, he was granted an MA in the Department of Systematics and Ecology by the University of Kansas, where he was mentored by William E. Duellman; his thesis was “Ecuadorian Frogs of the Genus *Colostethus* (Anura: Dendrobatidae).” For his PhD, he was under the guidance of Linda Trueb; in 1997, he completed his dissertation, “Morphology, Systematics, and Phylogenetic Relationships among Frogs of the Genus *Atelopus* (Anura: Bufonidae).” For 19 years, from 1991 to 2010, he was Professor and Senior Lecturer in charge of vertebrates and in charge of the herpetology section at the Escuela de Ciencias Biológicas at PUCE. He mentored 23 *licenciatura* students. Since 2011, he has been Director and Researcher at Centro Jambatu de Investigación y Conservación de Anfibios in Quito, Ecuador. Coloma has published 69 scientific papers, with 56 of these articles focused on amphibians and indexed in Scopus (as of 31 May 2023). Additionally, he has published 32 outreach publications, among the latter two coffee table photo books: *Ecuador Megadiverso* and *Sapos, Ecuador Sapodiverso*.

He has described or co-described 31 new species of frogs, among which, 28 are Ecuadorian frogs of the genera *Atelopus* (7), *Hyloxalus* (6), *Gastrotheca* (4), *Hyloscirtus* (4), *Engystomops* (3), *Pristimantis* (2), *Leucostethus* (1), and *Epipedobates* (1). Five species of frogs, one lizard, and one earthworm have been named in his honor by his colleagues. In 2007, he was awarded the Sabin Award for Conservation of Amphibians, presented by the World Conservation Union and Conservation International. In 2008, he received the Saint Louis Zoo Conservation Award in recognition of his extraordinary lifelong dedication to the conservation of Ecuadorian biodiversity. In 2009, he was appointed member of the Latin American Academy of Sciences. Additional

information about Coloma’s life appears in Chapter 2 of Volume I and references therein.

William E. Duellman (1930–2022)

Duellman was a herpetologist that was born in Dayton, Ohio, on 6 September 1930. He passed away on 25 February 2022. He earned three degrees from the University of Michigan—a BA (1951) in zoology with a minor in geography, an MS (1952) in zoology with a minor in botany, and a PhD (1956) in zoology with a minor in geology. His doctoral dissertation was on snakes of the genus *Leptodeira*. Since 1959, most of Duellman’s academic life was at the University of Kansas, where he was a professor in the Department of Systematics and Ecology and Curator and Curator Emeritus of Herpetology in the Natural History Museum (now Biodiversity Institute). He published 386 titles (among them 12 books). Among these books are *Hylid Frogs of Middle America*, *An Equatorial Herpetofauna*, *Biology of Amphibians* (with Linda Trueb); *Cusco Amazónico: Lives of Amphibians and Reptiles in a Tropical Rainforest*, *Terrestrial Breeding Frogs (Strabomantidae) in Peru* (with Edgar Lehr); and *Marsupial Frogs and Allied Genera*. Duellman served as Major Professor for 12 master’s and 34 PhD students, and he mentored seven post-doctoral scholars. During his time at the University of Kansas Natural History Museum, he built up the collection from 59,000 to more than 300,000 specimens through extensive field work by himself and with his students and by acquiring other collections, making it the fourth largest herpetological collection in the United States and by far the most significant collection of the herpetofauna of Latin America. He described or co-described 252 species of amphibians from the Neotropics, among which 93 are from Ecuador. Six species of frogs and five species of reptiles are named in his honor. Additional information about Duellman’s life is provided in Chapter 2 of Volume I and references therein.



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Contributors

Juan M. Guayasamin and Andrea Terán-Valdez assisted in the writing, review, and editing process of the Centroleniidae accounts. They are also credited alongside their contribution. Additional contributors include Juan C. Santos, who produced time-calibrated maximum likelihood phylogenetic trees illustrating the evolutionary relationships of amphibians in Ecuador, and Daniel J. Paluh, who assisted in the production of microCT images and high-resolution computed tomography reconstructions of the skeletons of Ecuadorian amphibian genera. The acknowledgments section further recognizes other contributions made by these individuals.

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Foreword

This Encyclopedia of *Amphibians of Ecuador* is not only the outcome of a lifetime of work by William E. Duellman (1930–2022) and Luis A. Coloma but also a tribute to the thriving and dynamic field of amphibian biology in Ecuador over recent decades. Duellman's contributions helped establish the foundation for amphibian research in Ecuador, upon which independent teams of researchers continue to build. Importantly, through his vision and mentorship, Duellman also fostered generations of Ecuadorian herpetologists, many of whom became leading figures in the field, including Coloma (Duellman, 2015).

I first met Luis A. Coloma as an undergraduate student at the Museo de Zoología of Pontificia Universidad Católica del Ecuador in 2003, where he was a professor and Head of the Herpetology Division. Like Duellman, Coloma's work ethic and unwavering dedication to the study of amphibians have motivated additional generations of Ecuadorian herpetologists and produced impactful science and conservation outcomes. Coloma's contagious curiosity and fascination for frogs began early in life, first as a child, and later as a high school student, when he naively designed an experiment testing the effects of temperature changes on frogs (Coloma, 2024)—a line of questioning that has since become an important focus within herpetology in the face of climate change!

Luis' eagerness to explore the biology of amphibians found an ideal complement in his lifetime collaboration with William E. Duellman, which began during his graduate studies at the University of Kansas. Upon his return to Ecuador, Coloma mentored a new generation of biologists, many of whom now make critical contributions to the study and conservation of amphibians. Witnessing the devastating declines of amphibian diversity firsthand, Coloma expanded his focus beyond just the science, spearheading initiatives to protect these species while at the same time empowering Ecuadorian scientists and citizens. Observing this evolution from close-up has been both a privilege and an inspiration.

The Encyclopedia provides an in-depth assessment of the amphibians of Ecuador, accompanied by photographs of exceptional quality. Volume IV features detailed accounts of Ecuadorian amphibians from the anuran families Phyllomedusidae, Leptodactylidae, Ceratophryidae, Hemiphractidae, Eleutherodactylidae, and Centrolenidae and the orders Gymnophiona and Caudata. Ecuador's remarkable amphibian discovery and description rate is among the highest globally, a trend highlighted throughout the Encyclopedia and especially in Appendix 2, which documents 20 new taxa described between 2023 and January 2025. While the discovery of new species and their evolutionary relationships will continue, this contribution will undoubtedly serve as a springboard for the further advancement of amphibian biology.

The families featured in Volume IV showcase the incredible diversity of Ecuadorian amphibians and their unique biological traits. Many species are emblematic of Neotropical amphibians. For instance, the distinctive morphology of most phyllomedusids evokes iconic images of tropical forest frogs. The calls of some *Engystomops* (Leptodactylidae) species in the lowland regions of the Pacific Coast, or the calls of *Gastrotheca* (Hemiphractidae) in the Andean highlands, are common sounds in the natural background. In terms of reproductive strategies, many leptodactylids create foam nests to protect their eggs, while marsupial frogs of the genus *Gastrotheca* have pouches on their backs where eggs are kept until they are released as tadpoles or froglets, depending on the species. The mesmerizing glassfrogs (Centrolenidae) display parental care, with males of many species guarding eggs laid on leaves over streams, from which tadpoles drop into the water to develop. Gymnophiona species also vary in reproductive mode, with some being oviparous or viviparous and certain larvae feeding on maternal tissue. This volume also includes species that have contributed to advancements in other fields of research, such as *Engystomops* and *Gastrotheca*, providing new insights to developmental biology through the pioneering work of Eugenia Del Pino and collaborators.

Reading through the pages of Volume IV evokes a blend of awe for the remarkable biology of these organisms and concern for their looming threats. Many species within each family are classified under one of the IUCN's threatened categories. In certain cases, particularly with Caudata and Gymnophiona, our understanding of their systematics, biology, and ecology is so limited that we are unable to definitively assess their conservation status or the threats they face. Some species, like *Ceratophrys stolzmanni* and *Gastrotheca cornuta*, are now part of *ex situ* conservation programs at the Centro Jambatu of Amphibian Research and Conservation aimed at boosting population sizes, maintaining backup populations, and eventually reintroducing them to their natural habitats. Others, such as *Agalychnis spurrelli* and *Cryziohyala craspedopus*, are not endangered but are involved in programs designed to combat the illegal pet trade by offering legal and sustainable alternatives. Many species have not been seen in decades; hopefully, with the dedication of the numerous herpetologists now working in our country, these species will be rediscovered.

What does the future hold? The work presented here reflects decades of effort and passion, which merely mark the beginning of a monumental challenge ahead. We are living in a thrilling era of research, where our understanding of biodiversity is expanding and deepening, and new techniques are offering unprecedented tools to explore questions we never thought possible. Yet these are also critical times, as our biodiversity urgently needs these advancements to combat the accelerating decline and extinction

rates of natural populations. As we continue to explore *what* species we discover, it is imperative that we also enquire *why* and *how* these species exist, coexist, survive, or vanish—all while developing multidisciplinary strategies to protect them. We must ask ourselves how we can harness

this knowledge in a rapidly changing world that desperately needs our efforts. I am confident that the work presented here will inspire many and that, through our endeavors, we will uncover answers along the way.

Mónica I. Páez-Vacas

Preface

In the Preface of Volume I, there is a general recounting and reflections on the purpose and history of the complete opus (Volumes I–IV). Here, the focus is on a few events and taxa to highlight broader issues mostly relevant to the taxonomy and systematics of Ecuadorian taxa, for which we have compiled accounts for each species, genus, family, and order. This Volume IV includes the accounts of 132 species of Ecuadorian anurans of the families Phyllomedusidae, Leptodactylidae, Ceratophryidae, Hemiphractidae, Eleutherodactylidae, and Centrolenidae; of 25 species of Gymnophiona; and of seven species of Caudata. It also includes an addendum with 20 new taxa described between January 2023 and January 2025.

In 1758, Carl von Linnaeus formalized the modern system of binomial nomenclature to name species, while also coining the binomial name (scientific name) for a species now known from Ecuador. The species is *Pipa pipa*, and his taxonomic action was solely based on illustrations of this frog originally collected in Suriname. Nearly a century passed before the first description of a frog named from Ecuador was made: *Atelopus ignescens* (the Jambato), described by the Italian scientist Emilio Cornalia in 1849 in a 15-line morphological account, which was an extensive description for those times. Two centuries later, in 1958, about 200 amphibian species were known from Ecuador. By 1980, this number had increased to 332 species, half of the species currently known in Ecuador, and they were described based on morphological evidence, with a few accounts also including osteological features and phylogenetic analyses, especially the taxonomic works by the research group at the University of Kansas, USA, led by William E. Duellman and Linda Trueb. By the end of 2022, when we ceased adding species to this opus, 655 species were known from Ecuador, and in the recent four decades, this was mostly due to efforts by Ecuadorian taxonomists and systematists. From 2023 up to January 2025, 27 additional, mostly cryptic species have been described, and we included 20 of them in an addendum in Volume IV. One of the most recent descriptions is that of a cryptic species by the Ecuadorian Pablo Menéndez-Guerrero and four collaborators (2024), *Rhinella bella* (beautiful toad), in a detailed 27-page paper that includes data and analyses based on extensive specimen collections, a molecular phylogenetic hypothesis, and the combined evidence of mtDNA sequence variation, morphology, bioacoustics, and environmental information.

The particular cases of *Pipa pipa*, *Atelopus ignescens*, and *Rhinella bella* illustrate the trend of taxonomic knowledge about amphibians in Ecuador, as well as the current accelerating pace, dynamism, and increasing complexity involved in describing this diversity, which is expected to increase substantially in the coming years (but see Löbl *et al.*, 2023), especially in a country like Ecuador, where

apparently no fewer than 230 species are awaiting discovery and description. However, this commendable progress is overshadowed by the poor or nonexistent knowledge in aspects of amphibian biology fields beyond morphology and DNA sequences (e.g., natural history data, calls, tadpoles, embryos, distributions, population dynamics, ethology) for most of the species, and even worse, by the possible extinction of nearly 50 of the known species, including an entire family of aquatic frogs, Telmatobiidae; a dozen *Atelopus* harlequin frogs; several monophasic marsupial frogs of the genus *Gastrotheca*; some craugastorids and *Hyloxalus* rocket frogs; and probably many other amphibians that were never documented.

The case of *Pipa pipa* helps to highlight the immense knowledge gaps that still need to be filled. For example, it is nearly unbelievable that a species such as *Pipa pipa* is still poorly known in Ecuador. In an era of genomics, paradoxically, its molecular phylogeny, its morphological and geographic variation, and its taxonomy are pending issues. This case highlights the missing pieces of basic systematic and taxonomic information and the still-inadequate samplings in museum collections. This is a generalized pattern also known for many other taxa (see, for example, Remarks for most species of the Microhylidae in Volume II or Gymnophiona in Volume IV).

Ironically, the case of the other mentioned species, *Atelopus ignescens*, whose taxonomy and systematics still have pending issues, serves to illustrate the catastrophe of amphibian extinctions and the desperate efforts to save a single population of an otherwise historically extremely abundant species having many populations. This has pushed the nascent Ecuadorian academic and conservationist community along with international collaborators to begin studying it in the contexts of population numbers, natural history, genomics, and ethnozoology (Vega-Yáñez *et al.*, 2024). However, this species is somehow privileged given its cultural importance, while many hundreds of others suffering the same path of extinction are still awaiting attention.

The most recently described species, such as *Rhinella bella*, which is an extremely common species, are based on integrative taxonomic practices, and this undoubtedly represents a step forward in gaining data and knowledge but also highlights the state of scientific developments, which are not free of controversy. This is especially true given contemporary discussions of still-contentious issues and fierce debates such as what defines a species, species boundaries, taxonomic anarchy, taxonomic inflation in the absence of appropriate geographic sampling, the discovery of cryptic diversity, genetic introgression, interspecific hybridization, and basic taxonomic practice-related topics (Garnett and Christidis, 2017; Cook *et al.*, 2023; Arias-Cárdenas *et al.*, 2024; Dubois *et al.*, 2024).

To advance knowledge in various biological fields and reverse the extinction trends of over 400 species, it is crucial to complete the description of Ecuadorian amphibians. This requires accelerating taxonomic research in Ecuador, significantly increasing governmental and international funding for museum collections and biobanks, digitizing collections, providing open access to information, and establishing legal frameworks that support the scientific exchange of taxonomic specimens and tissues to benefit biodiversity research.

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I really would urge you to cut off adding additional species at a logical time—e.g., no frogs described in 2023! Otherwise, you'll never see the end—kind of like Sisyphus pushing that stone ball up the side of the mountain.

As detailed in Chapter 2 (under the subtitle “From Anfibios de Ecuador to Amphibiawebecuador and to Anfibios del Ecuador-Bioweb at QCAZ”) and briefly mentioned in the preface, this opus is the descendant of earlier endeavors involving a vast collective of individuals and friends, encompassing students, collectors, field companions, scientists, administrators, and more. I extend my deepest gratitude for their invaluable contributions. Also, among them, I express my immense appreciation for their input while at Pontificia Universidad Católica del Ecuador goes to Giovanni Onore, Néstor Acosta-Buenaño, Ítalo G. Tapia, Elisa Bonaccorso, and Juan M. Guayasamin. Onore has always been a source of inspiration and drive, even in the most difficult times. Tapia (the Collection Manager at the QCAZ) aided, with great energy and empathy, in the field, in the museum, and with the photography of frogs and their development. Many of the photos in the field and in the lab would have not been possible without his collecting efforts and his ability to raise them. Bonaccorso and Guayasamin collaborated by leading the JRS and SENEYCYT projects, which, in 2008–2010, provided the funding necessary to enhance the electronic version of AmphibiaWebEcuador. Since 2011, all of these individuals have continued to offer their support in numerous ways during my tenure at Centro Jambatu of Amphibian Research and Conservation (CJ), and I am immensely grateful. In particular, Onore welcomed

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Finally, I dedicate this work with my profound and infinite gratitude to my extended family, and especially to Alexandra Quiguango Ubillús (my wife); to our sons, Pedro Antonio and José Miguel; and to my mother, Lida María Román. Their devoted emotional support surpasses any words I can write.

PHOTO AND ILLUSTRATION CREDITS

All photos and illustrations are appropriately credited in their respective figure captions. We have employed abbreviations for the primary authors of the majority of the photos, namely Luis A. Coloma (LAC), William E. Duellman (WED), Diego Acosta López (DAL) Steven and Guevara Salvador (SGS). The latter two worked at CJ focusing on photographic documentation and photo designing in 2016–2020 and from 2018 onwards, respectively. Steven generously and patiently assisted with the detective work

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Organization and Content of Accounts

Following are the accounts of each of the 132 species of Ecuadorian anurans of the families Phyllomedusidae, Leptodactylidae, Ceratophryidae, Hemiphractidae, Eleutherodactylidae, and Centrolenidae; of 25 species of Gymnophiona;

and of seven species of Caudata we recognize up to the year 2022. The Addendum in Appendix 2 includes accounts of 20 new species published between January 2023 and January 2025 (with submissions accepted until November 6, 2024).

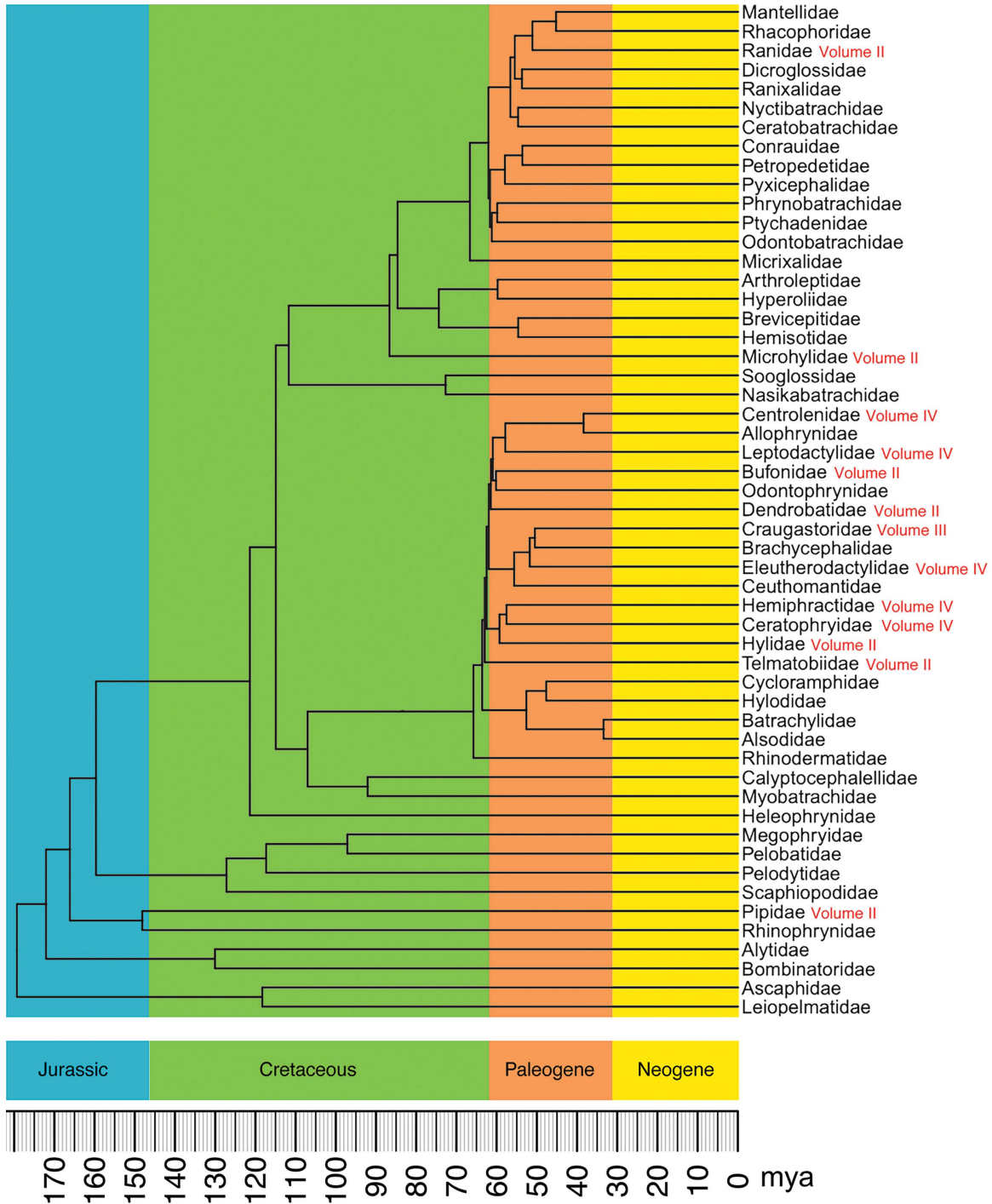


FIGURE 0.1 Topology of the families of Anura, extracted from a time-calibrated phylogenetic tree based on hundreds of loci. The families occurring in Ecuador are in red. The volume number in which the Ecuadorian families are included is indicated. Reprinted and modified from Portik *et al.* (2023) with permission from Elsevier Phyllomedusidae, which is not included in this figure, is covered in Volume IV.

Families of anurans are arranged phylogenetically from the oldest to the most recent lineages (see Figure 0.1). Accounts of genera and species of Anura are in alphabetical order within families. Within Caudata and Gymnophiona, accounts of families, genera, and species are arranged in alphabetical order.

Family and generic accounts include a section of contents. Each species account has the following structure:

- (1) The currently recognized taxon name followed by the name of the author(s) and year of publication. The discoverers of a species are the authors who describe it in accordance with the rules of the International Code of Zoological Nomenclature. The parentheses indicates that the original name has suffered changes through its taxonomic history. The scientific nomenclature is based on Frost (2023), with a few exceptions noted under Remarks of the corresponding account. Sometimes, the publication date that appears in a publication is different from the valid date when the work actually was published. In such cases, both dates are indicated in the references.
- (2) The common name. The English standard common name, chosen by us, is provided. A compilation of these names is also given in Table 0.1. The Spanish standard common name, chosen by us, is indicated in Table 0.1. The Spanish name is not necessarily a translation of the English standard common name (see “Standardized Names in Spanish and English” in Chapter 1 of Volume I).

The original name, author(s), year of publication, and page number. This is followed by type(s) information with museum number(s) and locality data. Type locality data were ordered from specific locality to country. In some cases, the spelling or description of the locality was corrected. Additionally, locality information was updated when necessary, such as current provincial allocations. Coordinates were excluded from this section, except when the type locality was not in Ecuador. For the original citations of locality data see Frost (2023 and onward).

- (3) Synonym. If nomenclatural changes occurred to the original name, only the most recent modification to that name is included. The new name is followed by the author(s), year of publication, and page number. The synonymy information was primarily sourced from Frost (2023). For comprehensive and detailed lists of synonyms, please refer to his website hosted by the American Museum of Natural History. We opt not to incorporate subgenus names such as *Duellmania* and *Huicundomantis*.
- (4) Distribution color bar. It represents the altitudinal regions of Ecuador. The bold line below the bar indicates the region of occurrence. From left to

right: western tropical (0–1000 m), western subtropical (1001–2000 m), western temperate (2001–3000 m), high Andean (3001–4800 m), eastern temperate (2001–3000 m), eastern subtropical (1001–2000 m), eastern tropical (0–1000 m).

- (5) Etymology. When available, the etymological description in the original description is included. Otherwise, the intended meaning is interpreted, usually based on the Greek or Latin derivation. In few cases, the vernacular name is also discussed.
- (6) Identification. In the accounts of orders, families, and genera we use Definition (instead of Identification). This section (diagnosis *sensu* Wiley and Lieberman, 2011) is intended to convey more than synapomorphies or autapomorphies and may include any characters useful in demonstrating that the taxon is different from other taxa. Thus, readers can identify members of the taxon in the most concise manner possible without having to consult more detailed descriptions. It provides the characteristics of the taxa, which alone or in combination help to distinguish the taxon from other taxa. Descriptions of the color are in life, unless otherwise indicated. When available, phenotypic synapomorphies for families and genera are described. This identification information is generally derived from the literature, which is indicated under Key references. The features used to characterize, diagnose, and distinguish vary according to the taxa, and we have nearly transcribed the characters used by the authors in the original descriptions or posterior taxonomic revisions. Nonetheless, in a few cases, and if necessary, we did some rewriting, made corrections, or added information. For several species, we offer information on known masses primarily derived from CJ data. Many of the characteristics of families are taken from Duellman and Trueb (1994), Frost *et al.* (2006), and especially from the compilation made by Vitt and Caldwell (2014), AmphibiaWeb (2022), and references cited therein, although in some cases, we updated the information. For nearly all genera, a microCT scan of the skeleton of a representative species is provided in dorsal and ventral views. Identifications of species are usually accompanied by plates depicting photos of males and females, intraspecific variation, and morphological details. We use the following morphological abbreviations throughout the text: SVL = snout–vent length, TL = total length for tadpoles, LTRF = labial tooth row formula.
- (7) Comparisons. Similar species are listed at the beginning of the paragraph, followed by comparisons to each of them. The comparisons were primarily conducted with Ecuadorian taxa; however, in some instances, comparisons were extended to include species from neighboring countries.

- (8) Tadpoles. Tadpole descriptions were transcribed from the literature, and their source is cited under Key references and also provided under Table 0.2. We present plates and, in some cases, descriptions for 44 species that were previously undescribed, along with images depicting ontogenetic changes for 135 species. The ontogenetic variation was photographically documented under laboratory conditions either at the QCAZ (from 1991 up to 2010) by LAC or at CJ (from 2011 to 2024), mostly by Coloma, Diego Acosta López, and Steven Guevara Salvador. In the figure legends of plates depicting tadpoles and ontogenetic changes, we include, when available, information on stage, size, and time of development. Color descriptions are based on the tadpoles in life, unless otherwise indicated.
- (9) Natural history. A synthesis of the most relevant aspects of these topics is provided, and the original sources or those that summarize them are mentioned under Key references. When relevant, collectors natural history data from specimens deposited at CJ were added. The information of CJ number and collector information can be found in the CJ species and specimens database. CJ laboratory notes were also included for species-maintained *ex situ*. Vocalizations are briefly described in this section, but a more complete account of vocalizations for each species is provided under the subtitle “Vocalizations of Ecuadorian Anurans” in Appendix 1. Sources of call descriptions are also compiled in Table 0.2.
- (10) Distribution. The distribution range in Ecuador and in other countries is outlined. Then, the species is located in the Ecuadorian provinces, and the altitude ranges in which it has been recorded are indicated, along with the area of extent of occurrence.
- (11) Conservation. The IUCN category, source of species categorization, and its justification are specified, accompanied by supporting details regarding the conservation status (refer also to “The Red List of Ecuadorian Amphibians” in Chapter 3 of Volume I). Additionally, a comprehensive compilation of categorizations for all species can be found in Table 0.2. Information is provided regarding the occurrence in state (public) protected reserves, protected forests, biosphere reserves, and some private reserves. It is explicitly mentioned whether the species is listed in CITES.
- (12) Content (order, families, genera accounts). The number of families, genera, and species worldwide is provided based on Frost (2023) up to December 2023, and the number of species in Ecuador follows this Encyclopedia.
- (13) Remarks. Any pertinent information and comments not included in other sections are provided herein. Additionally, if available, phylogenetic information and sources are provided in accounts for all taxa. Figures of phylogenetic trees including taxa not occurring in Ecuador (taken from the literature) are also given for many genera and some groups of species. Phylogenies published after December 2022, as well as recent molecular analyses and the phylogeny by Portik *et al.* (2023), are not included or discussed in the Encyclopedia, given that they were published after we ceased updating information, except where explicitly indicated (e.g., Figure 0.1). For example, we incorporated Strabomantidae within Craugastoridae, as suggested by Portik *et al.* (2023); we mentioned the papers by Franco-Mena *et al.* (2023) and Székely *et al.* (2023b) only when strictly necessary. The family accounts include a time-calibrated maximum likelihood phylogenetic tree depicting the evolutionary relationships of Ecuadorian species inferred from DNA sequences of mitochondrial and nuclear genes. The updated phylogeny of the Ecuadorian amphibian taxa up to the end 2021 was derived initially from alignments of the two largest phylogenetic reconstructions of amphibians to date (Pyron, 2014; Jetz and Pyron, 2018). The master alignments of both studies were appended, and taxa not found in Ecuador were removed; duplicate taxa were also removed by choosing the one with more sequence data, and taxonomic nomenclature was updated following AmphibiaWeb (2022). The final sequence alignment was realigned using DECIPHER (Wright, 2016) and manually reviewed and adjusted, particularly the mitochondrial ribosomal gene sequences. Multiple alignment programs were used to provide a good starting point, but adjustments were made by eye (Felsenstein, 2004; Baum and Smith, 2013). The optimized alignment was then used for the

Sometimes, the altitudes measured in the field do not exactly match those obtained from the coordinates in the geographic layers we used (WorldClim, Ver 2.1., Fick and Hijmans, 2017); thus, we generally report the altitudes provided in the original publication. In a separate paragraph, we specify the ecosystems and biogeographic sectors (Ministerio del Ambiente del Ecuador, 2013) where the species occurs, along with the average annual rainfall and temperature in their distributional ranges. We provide a compilation of the distribution of each of the species in the ecosystems (Tables 0.3 and 0.4) and biogeographic sectors (Table 0.5). Dot maps for each of the species are presented. We incorporated new distributional records, especially from the CJ collections, corrected errors, and made refinements to the level of precision of distribution records previously provided by Ortega-Andrade *et al.* (2021) (see more details under “The Red List of Ecuadorian Amphibians” in Chapter 3 of Volume I). The locality data used to build the maps are available at CJ.

phylogenetic estimation of sections of the global phylogeny; a maximum likelihood tree was estimated using IQ-TREE2 2.1.3 (Minh *et al.*, 2020), and node time constraints followed those of previous studies (Pyron, 2014; Jetz and Pyron, 2018). In some sections of the tree of Ecuadorian amphibians, the topology among the families of Hyloidea was constrained to match those of more comprehensive analyses with 100–1000s of nuclear genes and no mitochondrial data (Feng *et al.*, 2017; Hime *et al.*, 2021).

- (14) Key references. This section presents references relevant to the Ecuadorian amphibian orders and species accounts. It is not intended to be an exhaustive list of publications but rather a selection of the most relevant ones. For a comprehensive list of citations related to taxonomy, please refer to the most recent version of *Amphibian Species of the World* (Frost, 2023 and onward) or other revisionary works in specific fields. The references are presented in chronological order and include a brief description of the main topic covered. Additionally, authors of tadpole and call descriptions are acknowledged. This section includes the references corresponding to information provided in most sections of the account, with the exception of the Conservation and Remarks sections, which have citations integrated throughout the text.

INSTITUTIONAL AND MUSEUM ABBREVIATIONS

Throughout the text, we use acronyms for institutions and museums. For museum abbreviations, see Frost (2023 and onward). The most commonly used museum or institutional abbreviations are:

CJ	Centro Jambatu de Investigación y Conservación de Anfibios, Ecuador.
DHMECN	División de Herpetología, Museo Ecuatoriano de Ciencias Naturales (part of INABIO, Instituto Nacional de Biodiversidad, Ecuador since 2017).
EPN	(museum) Escuela Politécnica Nacional, Museo de Zoología, Ecuador.
KU	University of Kansas, Museum of Natural History, Division of Herpetology, USA.
MCZ	Museum of Comparative Zoology, Harvard University, USA.
MHNG	Muséum d'histoire Naturelle, Geneva.
QCAZ	Museo de Zoología, Pontificia Universidad Católica del Ecuador.
ZSFQ	Universidad San Francisco de Quito, Museo de Zoología, Ecuador.
USNM	National Museum of Natural History, Division of Amphibians and Reptiles, USA.
MZUTI	Universidad Tecnológica Indoamérica, Museo de Zoología, Ecuador.

TABLE 0.1

List of Suggested Common Names in English and Spanish for Species of Ecuadorian Amphibians
 See “Standardized Names in Spanish and English” in Chapter 1 in Volume I. * = Caudata, ** = Gymnophiona.

Centrolenidae	<i>Centrolene ballux</i>	Gold-dusted glassfrog	Rana de cristal dorada
Centrolenidae	<i>Centrolene buckleyi</i>	Buckley’s glassfrog	Rana de cristal de Buckley
Centrolenidae	<i>Centrolene charapita</i>	Charapita glassfrog	Rana de cristal charapita
Centrolenidae	<i>Centrolene condor</i>	Cóndor glassfrog	Rana de cristal de El Cóndor
Centrolenidae	<i>Centrolene geckoidea</i>	Gecko glassfrog	Rana de cristal gecko
Centrolenidae	<i>Centrolene heloderma</i>	Warty glassfrog	Rana de cristal verrugosa
Centrolenidae	<i>Centrolene huilensis</i>	Huila glassfrog	Rana de cristal de Huila
Centrolenidae	<i>Centrolene lynchi</i>	Lynch’s glassfrog	Rana de cristal de Lynch
Centrolenidae	<i>Centrolene medemi</i>	Medem’s glassfrog	Rana de cristal de Medem
Centrolenidae	<i>Centrolene peristicta</i>	Dappled glassfrog	Rana de cristal jaspeada
Centrolenidae	<i>Centrolene pipilata</i>	Peeping glassfrog	Rana de cristal espía
Centrolenidae	<i>Centrolene sanchezi</i>	Sanchez’s glassfrog	Rana de cristal de Sánchez
Centrolenidae	<i>Chimerella mariaelena</i>	María Elena’s glassfrog	Rana de cristal de María Elena
Centrolenidae	<i>Cochranella granulosa</i>	Granular glassfrog	Rana de cristal granular
Centrolenidae	<i>Cochranella litoralis</i>	Coast glassfrog	Rana de cristal litoral
Centrolenidae	<i>Cochranella mache</i>	Mache glassfrog	Rana de cristal de Mache
Centrolenidae	<i>Cochranella resplendens</i>	Resplendent glassfrog	Rana de cristal resplandeciente
Centrolenidae	<i>Espadarana audax</i>	Daring glassfrog	Rana de cristal atrevida
Centrolenidae	<i>Espadarana callistomma</i>	Pretty-eyed glassfrog	Rana de cristal de ojos bellos
Centrolenidae	<i>Espadarana durrellorum</i>	Durrell’s glassfrog	Rana de cristal de Durrell
Centrolenidae	<i>Espadarana prosoblepon</i>	Variable glassfrog	Rana de cristal variable
Centrolenidae	<i>Hyalinobatrachium adespinosai</i>	Adela’s glassfrog	Rana de cristal de Adela
Centrolenidae	<i>Hyalinobatrachium aureoguttatum</i>	Gold-spotted glassfrog	Rana de cristal de puntos dorados
Centrolenidae	<i>Hyalinobatrachium chirripoi</i>	Chirripó glassfrog	Rana de cristal Chirripó
Centrolenidae	<i>Hyalinobatrachium iaspidiense</i>	Jaspe’s glassfrog	Rana de cristal de Jaspe
Centrolenidae	<i>Hyalinobatrachium mashpi</i>	Mashpi glassfrog	Rana de cristal de Mashpi
Centrolenidae	<i>Hyalinobatrachium munozorum</i>	Muñoz’s glassfrog	Rana de cristal de Muñoz
Centrolenidae	<i>Hyalinobatrachium nouns</i>	Nouns’ glassfrog	Rana de cristal de Nouns
Centrolenidae	<i>Hyalinobatrachium pellucidum</i>	Crystal-clear glassfrog	Rana de cristal transparente
Centrolenidae	<i>Hyalinobatrachium tatayoi</i>	Tatayo’s glassfrog	Rana de cristal de Tatayo
Centrolenidae	<i>Hyalinobatrachium valerioi</i>	Valerio’s glassfrog	Rana de cristal de Valerio
Centrolenidae	<i>Hyalinobatrachium yaku</i>	Yaku glassfrog	Rana de cristal yaku
Centrolenidae	<i>Nymphargus anomalus</i>	Anomalous glassfrog	Rana de cristal anómala
Centrolenidae	<i>Nymphargus balionotus</i>	Spotted glassfrog	Rana de cristal salpicada
Centrolenidae	<i>Nymphargus buenaventura</i>	Buenaventura glassfrog	Rana de cristal de Buenaventura
Centrolenidae	<i>Nymphargus cariticommatus</i>	Unadorned glassfrog	Rana de cristal desadornada
Centrolenidae	<i>Nymphargus cochranae</i>	Cochran’s glassfrog	Rana de cristal de Cochran
Centrolenidae	<i>Nymphargus colomai</i>	Coloma’s glassfrog	Rana de cristal de Coloma
Centrolenidae	<i>Nymphargus garciae</i>	García’s glassfrog	Rana de cristal de García
Centrolenidae	<i>Nymphargus grandisonae</i>	Red-spotted glassfrog	Rana de cristal de puntos rojos
Centrolenidae	<i>Nymphargus griffithsi</i>	Griffiths’ glassfrog	Rana de cristal de Griffiths
Centrolenidae	<i>Nymphargus humboldti</i>	Humboldt’s glassfrog	Rana de cristal de Humboldt
Centrolenidae	<i>Nymphargus lasgralarias</i>	Las Gralarias glassfrog	Rana de cristal de Las Gralarias
Centrolenidae	<i>Nymphargus laurae</i>	Laura’s glassfrog	Rana de cristal de Laura
Centrolenidae	<i>Nymphargus lindae</i>	Linda’s glassfrog	Rana de cristal de Linda
Centrolenidae	<i>Nymphargus manduriacu</i>	Manduriacu glassfrog	Rana de cristal de Manduriacu
Centrolenidae	<i>Nymphargus mariae</i>	María’s glassfrog	Rana de cristal de María
Centrolenidae	<i>Nymphargus megacheirus</i>	Large-handed glassfrog	Rana de cristal de manos grandes
Centrolenidae	<i>Nymphargus megistus</i>	Greater Andean glassfrog	Rana andina grande
Centrolenidae	<i>Nymphargus posadae</i>	Posada’s glassfrog	Rana de cristal de Posada
Centrolenidae	<i>Nymphargus siren</i>	Siren glassfrog	Rana de cristal sirena
Centrolenidae	<i>Nymphargus sucre</i>	Sucre’s glassfrog	Rana de cristal de Sucre

(Continued)

TABLE 0.1 (Continued)

List of Suggested Common Names in English and Spanish for Species of Ecuadorian Amphibians
See “Standardized Names in Spanish and English” in Chapter 1 in Volume I. * = Caudata, ** = Gymnophiona.

Centrolenidae	<i>Nymphargus wileyi</i>	Wiley’s glassfrog	Rana de cristal de Wiley
Centrolenidae	<i>Rulyrana flavopunctata</i>	Yellow-spotted glassfrog	Rana de cristal de manchas amarillas
Centrolenidae	<i>Rulyrana mediarmidi</i>	McDiarmid’s glassfrog	Rana de cristal de McDiarmid
Centrolenidae	<i>Sachatamia albomaculata</i>	White-spotted glassfrog	Rana de cristal de puntos blancos
Centrolenidae	<i>Sachatamia ilex</i>	Holly’s glassfrog	Rana de cristal de Holly
Centrolenidae	<i>Sachatamia orejuela</i>	Orejuela’s glassfrog	Rana de cristal de Orejuela
Centrolenidae	<i>Teratohyla ameliae</i>	Amélie’s glassfrog	Rana de cristal de Amélie
Centrolenidae	<i>Teratohyla midas</i>	Midas’ glassfrog	Rana de cristal de Midas
Centrolenidae	<i>Teratohyla pulverata</i>	Dusty glassfrog	Rana de cristal polvoriento
Centrolenidae	<i>Teratohyla spinosa</i>	Dwarf glassfrog	Rana de cristal enana
Centrolenidae	<i>Vitreorana ritae</i>	Rita’s glassfrog	Rana de cristal de Rita
Ceratophryidae	<i>Ceratophrys cornuta</i>	Horned Pac-Man frog	Sapo pacman de cuernos
Ceratophryidae	<i>Ceratophrys stolzmanni</i>	Stolzmann’s Pac-Man frog	Sapo pacman de Stolzmann
Eleutherodactylidae	<i>Adelophryne adiastrata</i>	Confused hammer frog	Ranita martillo confusa
Eleutherodactylidae	<i>Diasporus gularis</i>	Orange little hammer frog	Ranita martillo naranja
Hemiphractidae	<i>Gastrotheca cuencana</i>	Cuenca marsupial frog	Rana marsupial de Cuenca
Hemiphractidae	<i>Gastrotheca elicioi</i>	Elicio’s marsupial frog	Rana marsupial de Elicio
Hemiphractidae	<i>Gastrotheca litonensis</i>	Busa marsupial frog	Rana marsupial de Busa
Hemiphractidae	<i>Gastrotheca lojana</i>	Lojana marsupial frog	Rana marsupial Lojana
Hemiphractidae	<i>Gastrotheca plumbea</i>	Plumbeus marsupial frog	Rana marsupial plúmbea
Hemiphractidae	<i>Gastrotheca pseustes</i>	Liar marsupial frog	Rana marsupial mentirosa
Hemiphractidae	<i>Gastrotheca psychrophila</i>	Cold marsupial frog	Rana marsupial de frío
Hemiphractidae	<i>Gastrotheca riobambae</i>	Gualataco marsupial frog	Rana marsupial gualataco
Hemiphractidae	<i>Gastrotheca turnerorum</i>	Turner’s marsupial frog	Rana marsupial de Turner
Hemiphractidae	<i>Gastrotheca yacuri</i>	Yacuri marsupial frog	Rana marsupial de Yacuri
Hemiphractidae	<i>Gastrotheca andaquiensis</i>	Andaqui marsupial frog	Rana marsupial Andaquí
Hemiphractidae	<i>Gastrotheca angustifrons</i>	Thin-snouted marsupial frog	Rana marsupial de nariz estrecha
Hemiphractidae	<i>Gastrotheca cornuta</i>	Horned marsupial frog	Rana marsupial con cuernos
Hemiphractidae	<i>Gastrotheca dendronastes</i>	Arboreal marsupial frog	Rana marsupial arbórea
Hemiphractidae	<i>Gastrotheca espeletia</i>	Espeletia marsupial frog	Rana marsupial de espeletia
Hemiphractidae	<i>Gastrotheca guentheri</i>	Lower-Toothed marsupial frog	Rana marsupial dentada
Hemiphractidae	<i>Gastrotheca longipes</i>	Long-footed marsupial frog	Rana marsupial de pies largos
Hemiphractidae	<i>Gastrotheca orophylax</i>	Guardian marsupial frog	Rana marsupial guardiana
Hemiphractidae	<i>Gastrotheca testudinea</i>	Tortoise marsupial frog	Rana marsupial tortuga
Hemiphractidae	<i>Gastrotheca weinlandii</i>	Weinland’s marsupial frog	Rana marsupial de Weinland
Hemiphractidae	<i>Hemiphraactus bubalus</i>	Crested casque-headed frog	Rana de casco crestada
Hemiphractidae	<i>Hemiphraactus fasciatus</i>	Banded casque-headed frog	Rana de casco bandeada
Hemiphractidae	<i>Hemiphraactus helioi</i>	Helio’s casque-headed frog	Rana de casco de Helio
Hemiphractidae	<i>Hemiphraactus proboscideus</i>	Long-snouted casque-headed frog	Rana de casco narizona
Hemiphractidae	<i>Hemiphraactus scutatus</i>	Helmeted casque-headed frog	Rana de casco protector
Leptodactylidae	<i>Adenomera andreae</i>	Göldi’s thin-toed frog	Rana dedilarga de Göldi
Leptodactylidae	<i>Adenomera hylaedactyla</i>	Dark-spotted thin-toed frog	Rana dedilarga de manchas oscuras
Leptodactylidae	<i>Edalorhina perezii</i>	Perez’s foam-nest frog	Rana de espuma de Pérez
Leptodactylidae	<i>Engystomops coloradorum</i>	Colorado bully foam toad	Sapito bullanguero Colorado
Leptodactylidae	<i>Engystomops guayaco</i>	Guayaco bully foam toad	Sapito bullanguero guayaco
Leptodactylidae	<i>Engystomops montubio</i>	Montubio bully foam toad	Sapito bullanguero montubio
Leptodactylidae	<i>Engystomops petersi</i>	Peters’ bully foam toad	Sapito bullanguero de Peters
Leptodactylidae	<i>Engystomops pustulatus</i>	Blistered bully foam toad	Sapito bullanguero ampollado
Leptodactylidae	<i>Engystomops puyango</i>	Puyango bully foam toad	Sapito bullanguero de Puyango
Leptodactylidae	<i>Engystomops randi</i>	Rand’s bully foam toad	Sapito bullanguero de Rand
Leptodactylidae	<i>Leptodactylus discodactylus</i>	Disc-shaped thin-toed frog	Rana dedilarga discada
Leptodactylidae	<i>Leptodactylus knudseni</i>	Knudsen’s thin-toed frog	Rana dedilarga de Knudsen
Leptodactylidae	<i>Leptodactylus labrosus</i>	Thick-lipped thin-toed frog	Rana dedilarga de labio grueso

TABLE 0.1 (Continued)

List of Suggested Common Names in English and Spanish for Species of Ecuadorian Amphibians

See "Standardized Names in Spanish and English" in Chapter 1 in Volume I. * = Caudata, ** = Gymnophiona.

Leptodactylidae	<i>Leptodactylus leptodactyloides</i>	Thin-toed frog	Rana dedilarga
Leptodactylidae	<i>Leptodactylus melanonotus</i>	Black-back thin-toed frog	Rana dedilarga dorsinegra
Leptodactylidae	<i>Leptodactylus mystaceus</i>	Mustache thin-toed frog	Rana dedilarga con bigote
Leptodactylidae	<i>Leptodactylus pentadactylus</i>	Gualag thin-toed frog	Rana dedilarga gualag
Leptodactylidae	<i>Leptodactylus peritoaktites</i>	Coastal dweller thin-toed frog	Rana dedilarga de la costa
Leptodactylidae	<i>Leptodactylus petersii</i>	Peters' thin-toed frog	Rana dedilarga de Peters
Leptodactylidae	<i>Leptodactylus rhodomerus</i>	Rose-thigh thin-toed frog	Rana dedilarga de muslos rosados
Leptodactylidae	<i>Leptodactylus rhodomystax</i>	Rose-lipped thin-toed frog	Rana dedilarga de labios rosados
Leptodactylidae	<i>Leptodactylus stenodema</i>	Popoco thin-toed frog	Rana dedilarga popoco
Leptodactylidae	<i>Leptodactylus ventrimaculatus</i>	Spotted-venter thin-toed frog	Rana dedilarga de vientre punteado
Leptodactylidae	<i>Leptodactylus wagneri</i>	Wagner's thin-toed frog	Rana dedilarga de Wagner
Leptodactylidae	<i>Lithodytes lineatus</i>	Striped ant-nest frog	Rana listada hormiguera
Phyllomedusidae	<i>Agalychnis buckleyi</i>	Buckley's leaf frog	Rana de hoja de Buckley
Phyllomedusidae	<i>Agalychnis hulli</i>	Hull's leaf frog	Rana de hoja de Hull
Phyllomedusidae	<i>Agalychnis psilopygion</i>	Smooth leaf frog	Rana de hoja lisa
Phyllomedusidae	<i>Agalychnis spurrelli</i>	Spurrell's gliding leaf frog	Rana de hoja de Spurrell
Phyllomedusidae	<i>Callimedusa ecuatoriana</i>	Ecuadorian leaf frog	Rana de hoja ecuatoriana
Phyllomedusidae	<i>Callimedusa perinesos</i>	Purple leaf frog	Rana de hoja púrpura
Phyllomedusidae	<i>Callimedusa tomopterna</i>	Tiger-striped leaf frog	Rana mono rayada tigre
Phyllomedusidae	<i>Cruziohyla calcarifer</i>	Splendid leaf frog	Rana de hoja espléndida
Phyllomedusidae	<i>Cruziohyla craspedopus</i>	Fringed leaf frog	Rana de hoja con flecos
Phyllomedusidae	<i>Phyllomedusa tarsius</i>	Tarsus leaf frog	Rana de hoja de tarso
Phyllomedusidae	<i>Phyllomedusa vaillantii</i>	White-lined leaf frog	Rana de hoja de línea blanca
Phyllomedusidae	<i>Pithecopus palliatus</i>	Mantle leaf frog	Rana de hoja de manto
*Plethodontidae	<i>Bolitoglossa chica</i>	Tiny mushroom tongue salamander	Salamandra apulmonada minúscula
*Plethodontidae	<i>Bolitoglossa ecuatoriana</i>	Ecuadorian mushroom tongue salamander	Salamandra apulmonada ecuatoriana
*Plethodontidae	<i>Bolitoglossa medemi</i>	Medem's mushroom tongue salamander	Salamandra apulmonada de Medem
*Plethodontidae	<i>Bolitoglossa palmata</i>	Webbed mushroom tongue salamander	Salamandra apulmonada con membranas
*Plethodontidae	<i>Bolitoglossa sima</i>	Snub-nosed mushroom tongue salamander	Salamandra apulmonada de nariz corta
*Plethodontidae	<i>Oedipina ecuatoriana</i>	Ecuadorian worm salamander	Salamandra gusano ecuatoriana
*Plethodontidae	<i>Oedipina villamizariorum</i>	Villamizar's worm salamander	Salamandra gusano de Villamizar
**Caeciliidae	<i>Caecilia abitaguae</i>	Abitagua caecilian	Ilulo de Abitagua
**Caeciliidae	<i>Caecilia albiventris</i>	White-bellied caecilian	Ilulo de vientre blanco
**Caeciliidae	<i>Caecilia attenuata</i>	Attenuated caecilian	Ilulo atenuado
**Caeciliidae	<i>Caecilia bokermanni</i>	Bokermann's caecilian	Ilulo de Bokermann
**Caeciliidae	<i>Caecilia buckleyi</i>	Buckley's caecilian	Ilulo de Buckley
**Caeciliidae	<i>Caecilia crassisquama</i>	Thick caecilian	Ilulo grueso
**Caeciliidae	<i>Caecilia disossea</i>	Bony caecilian	Ilulo óseo
**Caeciliidae	<i>Caecilia dunni</i>	Dunn's caecilian	Ilulo de Dunn
**Caeciliidae	<i>Caecilia guntheri</i>	Günther's caecilian	Ilulo de Günther
**Caeciliidae	<i>Caecilia leucocephala</i>	White-headed caecilian	Ilulo de cabeza blanca
**Caeciliidae	<i>Caecilia nigricans</i>	Black caecilian	Ilulo negro
**Caeciliidae	<i>Caecilia orientalis</i>	Eastern caecilian	Ilulo del oriente
**Caeciliidae	<i>Caecilia pachynema</i>	Giant caecilian	Ilulo gigante
**Caeciliidae	<i>Caecilia subterminalis</i>	Taylor's caecilian	Ilulo de Taylor
**Caeciliidae	<i>Caecilia tentaculata</i>	Yamba caecilian	Ilulo yamba
**Caeciliidae	<i>Caecilia tenuissima</i>	Guayaquil caecilian	Ilulo de Guayaquil
**Caeciliidae	<i>Oscaecilia bassleri</i>	Bassler's caecilian	Ilulo de Bassler
**Caeciliidae	<i>Oscaecilia equatorialis</i>	Ecuadorian caecilian	Ilulo ecuatoriano
**Rhinatreumatidae	<i>Amazops amazops</i>	Amazonian-tailed caecilian	Ilulo colilarga amazónico
**Rhinatreumatidae	<i>Epicrionops bicolor</i>	Bicolor caecilian	Ilulo bicolor
**Rhinatreumatidae	<i>Epicrionops petersi</i>	Peters' caecilian	Ilulo de Peters
**Siphonopidae	<i>Microcaecilia albiceps</i>	Pale-headed caecilian	Ilulo de cabeza alba
**Siphonopidae	<i>Siphonops annulatus</i>	Ringed caecilian	Ilulo anillado
**Typhlonectidae	<i>Chthonerpeton onorei</i>	Onore's caecilian	Ilulo de Onore
**Typhlonectidae	<i>Potomotyphlus kaupii</i>	Kaup's caecilian	Ilulo de Kaup

TABLE 0.2

Summary of Endemism, Red List Categories, and Citations of References for Which Tadpole and Call Descriptions of 655 Amphibians from Ecuador Have Been Published.

Family	Species	End	Rel List	Tadpole References	Call References
Centrolenidae	<i>Centrolene ballux</i>		EN	Guayasamin <i>et al.</i> (this publication)	Márquez <i>et al.</i> (1996)
Centrolenidae	<i>Centrolene buckleyi</i>		CR	Guayasamin <i>et al.</i> (this publication)	Guayasamin <i>et al.</i> (2020b)
Centrolenidae	<i>Centrolene charapita</i>		CR	Guayasamin <i>et al.</i> (this publication)	Non-described
Centrolenidae	<i>Centrolene condor</i>	E	EN	Guayasamin <i>et al.</i> (2020b)	Almendáriz and Batallas (2012)
Centrolenidae	<i>Centrolene geckoidea</i>		CR (PE)	Lynch <i>et al.</i> (1983), Rueda-Almonacid (1994)	Non-described
Centrolenidae	<i>Centrolene heloderma</i>		EN	Guayasamin <i>et al.</i> (this publication)	Guayasamin <i>et al.</i> (2020b)
Centrolenidae	<i>Centrolene huilensis</i>		DD	Non-described	Non-described
Centrolenidae	<i>Centrolene lynchi</i>		EN	Non-described	Dautel <i>et al.</i> (2011)
Centrolenidae	<i>Centrolene medemi</i>		CR	Non-described	Non-described
Centrolenidae	<i>Centrolene peristicta</i>		NT	Guayasamin <i>et al.</i> (this publication)	Salgado and Guayasamin (2018)
Centrolenidae	<i>Centrolene pipilata</i>	E	CR (PE)	Non-described	Non-described
Centrolenidae	<i>Centrolene sanchezi</i>		EN	Guayasamin <i>et al.</i> (this publication)	Guayasamin <i>et al.</i> (2020b)
Centrolenidae	<i>Chimerella mariaeleanae</i>	E	NT	Terán Valdez and Guayasamin (2014)	Batallas and Brito (2016); Guayasamin <i>et al.</i> (2020b)
Centrolenidae	<i>Cochranella granulosa</i>		DD	Starrett (1960); Hoffmann (2010)	Kubicki (2007)
Centrolenidae	<i>Cochranella litoralis</i>		EN	Non-described	Non-described
Centrolenidae	<i>Cochranella mache</i>		EN	Non-described	Ortega-Andrade <i>et al.</i> (2013)
Centrolenidae	<i>Cochranella resplendens</i>		LC	Terán-Valdez <i>et al.</i> (2009)	Non-described
Centrolenidae	<i>Espadarana audax</i>		NT	Guayasamin <i>et al.</i> (this publication)	Guayasamin <i>et al.</i> (2020b)
Centrolenidae	<i>Espadarana callistomma</i>		EN	Non-described	Guayasamin <i>et al.</i> (2020b)
Centrolenidae	<i>Espadarana durrellorum</i>		LC	Non-described	Non-described
Centrolenidae	<i>Espadarana prosoblepon</i>		LC	McCranie and Wilson (2002); Starrett (1960); Savage (2002)	Guayasamin <i>et al.</i> (2020b)
Centrolenidae	<i>Hyalinobatrachium adespinosai</i>	E	DD	Non-described	Guayasamin <i>et al.</i> (2020b)
Centrolenidae	<i>Hyalinobatrachium aureoguttatum</i>		EN	Ibañez <i>et al.</i> (1999a); Terán-Valdez <i>et al.</i> (2009)	Non-described
Centrolenidae	<i>Hyalinobatrachium chirripoi</i>		EN	Hoffmann (2010)	Guayasamin <i>et al.</i> (2020b)
Centrolenidae	<i>Hyalinobatrachium iaspidiense</i>		NT	Non-described	Señaris and Ayarzagüena (2005)
Centrolenidae	<i>Hyalinobatrachium mashpi</i>	E	EN	Non-described	Guayasamin <i>et al.</i> (2022)
Centrolenidae	<i>Hyalinobatrachium munozorum</i>		LC	Guayasamin <i>et al.</i> (this publication)	Guayasamin <i>et al.</i> (2020b)
Centrolenidae	<i>Hyalinobatrachium nouns</i>	E	EN	Non-described	Non-described
Centrolenidae	<i>Hyalinobatrachium pellucidum</i>	E	VU	Non-described	Guayasamin <i>et al.</i> (2020b)
Centrolenidae	<i>Hyalinobatrachium tatayoi</i>		NT	Guayasamin <i>et al.</i> (this publication)	Castroviejo-Fisher <i>et al.</i> (2007)
Centrolenidae	<i>Hyalinobatrachium valerioi</i>		EN	See Remarks in account	See Remarks in account
Centrolenidae	<i>Hyalinobatrachium yaku</i>	E	DD	Non-described	Guayasamin <i>et al.</i> (2017)
Centrolenidae	<i>Nymphargus anomalus</i>	E	EN	Guayasamin <i>et al.</i> (this publication)	Non-described
Centrolenidae	<i>Nymphargus balionotus</i>		EN	Non-described	Non-described

TABLE 0.2 (Continued)

Summary of Endemism, Red List Categories, and Citations of References for Which Tadpole and Call Descriptions of 655 Amphibians from Ecuador Have Been Published.

Family	Species	End	Rel List	Tadpole References	Call References
Centrolenidae	<i>Nymphargus buenaventura</i>		EN	Non-described	Non-described
Centrolenidae	<i>Nymphargus caritocommatus</i>	E	EN	Non-described	Non-described
Centrolenidae	<i>Nymphargus cochranae</i>	E	VU	Guayasamin <i>et al.</i> (this publication)	Non-described
Centrolenidae	<i>Nymphargus colomai</i>	E	EN	Non-described	Non-described
Centrolenidae	<i>Nymphargus garciae</i>		EN	Non-described	Non-described
Centrolenidae	<i>Nymphargus grandisonae</i>		LC	Ospina-Sarria <i>et al.</i> (2011)	Hutter <i>et al.</i> (2013)
Centrolenidae	<i>Nymphargus griffithsi</i>		VU	Guayasamin <i>et al.</i> (this publication)	Hutter and Guayasamin (2012)
Centrolenidae	<i>Nymphargus humboldti</i>	E	EN	Non-described	Non-described
Centrolenidae	<i>Nymphargus lasgralarias</i>	E	EN	Non-described	Hutter and Guayasamin (2012)
Centrolenidae	<i>Nymphargus laurae</i>	E	CR	Non-described	Non-described
Centrolenidae	<i>Nymphargus lindae</i>	E	EN	Non-described	Non-described
Centrolenidae	<i>Nymphargus manduriacu</i>	E	CR	Non-described	Guayasamin <i>et al.</i> (2019a)
Centrolenidae	<i>Nymphargus mariae</i>		LC	Non-described	Guayasamin <i>et al.</i> (2020b)
Centrolenidae	<i>Nymphargus megacheirus</i>		CR	Non-described	Non-described
Centrolenidae	<i>Nymphargus megistus</i>		EN	Non-described	Non-described
Centrolenidae	<i>Nymphargus posadae</i>		LC	Non-described	Non-described
Centrolenidae	<i>Nymphargus siren</i>		EN	Guayasamin <i>et al.</i> (this publication)	Guayasamin <i>et al.</i> (2020b)
Centrolenidae	<i>Nymphargus sucre</i>	E	CR	Non-described	Non-described
Centrolenidae	<i>Nymphargus wileyi</i>	E	DD	Non-described	Non-described
Centrolenidae	<i>Rulyrana flavopunctata</i>		VU	Non-described	Guayasamin <i>et al.</i> (2020b)
Centrolenidae	<i>Rulyrana mcdiarmidi</i>		VU	Non-described	Non-described
Centrolenidae	<i>Sachatamia albomaculata</i>		VU	Hoffmann (2010)	Non-described
Centrolenidae	<i>Sachatamia ilex</i>		EN	Hoffmann (2010)	Guayasamin <i>et al.</i> (2020b)
Centrolenidae	<i>Sachatamia orejuela</i>		EN	Non-described	Brunner and Guayasamin (2020)
Centrolenidae	<i>Teratohyla amelie</i>		LC	Non-described	Guayasamin <i>et al.</i> (2020b)
Centrolenidae	<i>Teratohyla midas</i>		LC	Guayasamin <i>et al.</i> (this publication)	Guayasamin <i>et al.</i> (2020b)
Centrolenidae	<i>Teratohyla pulverata</i>		VU	Hoffmann (2004)	Ibañez <i>et al.</i> (1999b); Kubicki (2007)
Centrolenidae	<i>Teratohyla spinosa</i>		VU	Savage (2002)	Guayasamin <i>et al.</i> (2020b)
Centrolenidae	<i>Vitreorana ritae</i>		LC	Guayasamin <i>et al.</i> (2020b); Schiesari <i>et al.</i> (2022)	Guayasamin <i>et al.</i> (2020b)
Ceratophryidae	<i>Ceratophrys cornuta</i>		LC	Duellman (1978, 2005); Schiesari <i>et al.</i> (2022)	Schlüter (1980); Duellman (2005)
Ceratophryidae	<i>Ceratophrys stolzmanni</i>		VU	Non-described	Non-described
Eleutherodactylidae	<i>Adelophryne adiastrata</i>		LC	N/A	Heyer (1977)
Eleutherodactylidae	<i>Diasporus gularis</i>		EN	N/A	Non-described
Hemiphractidae	<i>Gastrotheca cuencana</i>	E	EN	Carvajal-Endara <i>et al.</i> (2019)	Carvajal-Endara <i>et al.</i> (2019)
Hemiphractidae	<i>Gastrotheca eliciei</i>	E	EN	Carvajal-Endara <i>et al.</i> (2019)	Carvajal-Endara <i>et al.</i> (2019)
Hemiphractidae	<i>Gastrotheca litonedis</i>	E	CR	Carvajal-Endara <i>et al.</i> (2019)	Carvajal-Endara <i>et al.</i> (2019)
Hemiphractidae	<i>Gastrotheca lojana</i>	E	CR	Carvajal-Endara <i>et al.</i> (2019)	Carvajal-Endara <i>et al.</i> (2019)
Hemiphractidae	<i>Gastrotheca plumbea</i>	E	EN	N/A	Sinsch and Juraske (2006)

(Continued)

TABLE 0.2 (Continued)

Summary of Endemism, Red List Categories, and Citations of References for Which Tadpole and Call Descriptions of 655 Amphibians from Ecuador Have Been Published.

Family	Species	End	Rel List	Tadpole References	Call References
Hemiphractidae	<i>Gastrotheca pseustes</i>	E	NT	Carvajal-Endara <i>et al.</i> (2019)	Carvajal-Endara <i>et al.</i> (2019)
Hemiphractidae	<i>Gastrotheca psychrophila</i>	E	CR (PE)	Non-described	Non-described
Hemiphractidae	<i>Gastrotheca riobambae</i>	E	EN	Duellman (2015)	Sinsch and Juraske (2006)
Hemiphractidae	<i>Gastrotheca turnerorum</i>	E	EN	Carvajal-Endara <i>et al.</i> (2019)	Non-described
Hemiphractidae	<i>Gastrotheca yacuri</i>	E	CR	Non-described	Carvajal-Endara <i>et al.</i> (2019)
Hemiphractidae	<i>Gastrotheca andaquiensis</i>		CR (PE)	N/A	Non-described
Hemiphractidae	<i>Gastrotheca angustifrons</i>		CR (PE)	N/A	Non-described
Hemiphractidae	<i>Gastrotheca cornuta</i>		EN	N/A	Duellman (2015)
Hemiphractidae	<i>Gastrotheca dendronastes</i>		CR (PE)	N/A	Non-described
Hemiphractidae	<i>Gastrotheca espeletia</i>		EN	Duellman (2015)	Sinsch and Juraske (2006)
Hemiphractidae	<i>Gastrotheca guentheri</i>		CR (PE)	N/A	Non-described
Hemiphractidae	<i>Gastrotheca longipes</i>		NT	N/A	Non-described
Hemiphractidae	<i>Gastrotheca orophylax</i>		EN	N/A	Sinsch and Juraske (2006)
Hemiphractidae	<i>Gastrotheca testudinea</i>		NT	N/A	Carvajal-Endara <i>et al.</i> (2019)
Hemiphractidae	<i>Gastrotheca weinlandii</i>		CR (PE)	N/A	Non-described
Hemiphractidae	<i>Hemiphractus bubalus</i>		NT	N/A	Non-described
Hemiphractidae	<i>Hemiphractus fasciatus</i>		CR (PE)	N/A	Non-described
Hemiphractidae	<i>Hemiphractus helioi</i>		CR (PE)	N/A	Non-described
Hemiphractidae	<i>Hemiphractus proboscideus</i>		NT	N/A	Non-described
Hemiphractidae	<i>Hemiphractus scutatus</i>		LC	N/A	Non-described
Leptodactylidae	<i>Adenomera andreae</i>		LC	Schiesari <i>et al.</i> (2022)	Marquez <i>et al.</i> (1995); Angulo <i>et al.</i> (2003)
Leptodactylidae	<i>Adenomera hylaedactyla</i>		LC	Heyer and Silverstone (1969); Schiesari <i>et al.</i> (2022)	Marquez <i>et al.</i> (1995); Angulo <i>et al.</i> (2003)
Leptodactylidae	<i>Edalorhina perezii</i>		LC	Schlüter (1990); Duellman (2005); do Nascimento <i>et al.</i> (2021)	Schlüter (1980, 1990); Duellman (2005)
Leptodactylidae	<i>Engystomops coloradorum</i>	E	EN	Cannatella and Duellman (1984)	Ron <i>et al.</i> (2005)
Leptodactylidae	<i>Engystomops guayaco</i>	E	VU	Ron <i>et al.</i> (2005)	Ron <i>et al.</i> (2005)
Leptodactylidae	<i>Engystomops montubio</i>	E	LC	Non-described	Ron <i>et al.</i> (2004)
Leptodactylidae	<i>Engystomops petersi</i>		LC	Duellman (1978)	Guerra and Ron (2008)
Leptodactylidae	<i>Engystomops pustulatus</i>		LC	Terán-Valdez and Coloma (this publication)	Ron <i>et al.</i> (2010)
Leptodactylidae	<i>Engystomops puyango</i>	E	NT	Non-described	Ron <i>et al.</i> (2004, 2010)
Leptodactylidae	<i>Engystomops randi</i>	E	LC	Terán-Valdez and Coloma (this publication)	Ron <i>et al.</i> (2004)
Leptodactylidae	<i>Leptodactylus discodactylus</i>		LC	Duellman (1978) (uncertain)	Straughan and Heyer (1976)
Leptodactylidae	<i>Leptodactylus knudseni</i>		LC	Hero (1990); Schiesari <i>et al.</i> (2022)	Heyer (2005)
Leptodactylidae	<i>Leptodactylus labrosus</i>		LC	Terán-Valdez and Coloma (this publication)	de Carvalho and Ron (2011)
Leptodactylidae	<i>Leptodactylus leptodactyloides</i>		LC	Heyer (1994)	Heyer (1994)
Leptodactylidae	<i>Leptodactylus melanotus</i>		LC	McCranie and Wilson (2002)	Straughan and Heyer (1976)
Leptodactylidae	<i>Leptodactylus mystaceus</i>		LC	Heyer (1978); Schiesari <i>et al.</i> (2022)	Heyer <i>et al.</i> (1996)

TABLE 0.2 (Continued)

Summary of Endemism, Red List Categories, and Citations of References for Which Tadpole and Call Descriptions of 655 Amphibians from Ecuador Have Been Published.

Family	Species	End	Rel List	Tadpole References	Call References
Leptodactylidae	<i>Leptodactylus pentadactylus</i>		NT	Menin <i>et al.</i> (2010); Schiesari <i>et al.</i> (2022)	Heyer (2005)
Leptodactylidae	<i>Leptodactylus peritoaktites</i>	E	EN	Non-described	Heyer (2005)
Leptodactylidae	<i>Leptodactylus petersii</i>		LC	Duellman (2005); Schiesari <i>et al.</i> (2022)	Heyer (1994)
Leptodactylidae	<i>Leptodactylus rhodomerus</i>		VU	Non-described	Non-described
Leptodactylidae	<i>Leptodactylus rhodomystax</i>		LC	Rodrigues <i>et al.</i> (2007); Duellman (1978); Hero (1990); Schiesari <i>et al.</i> (2022)	Zimmerman and Bogart (1984); de Sá <i>et al.</i> (2014)
Leptodactylidae	<i>Leptodactylus stenodema</i>		NT	Non-described	Heyer (1979); Lescure and Marty (2000)
Leptodactylidae	<i>Leptodactylus ventrimaculatus</i>		LC	Terán-Valdez and Coloma (this publication)	Non-described
Leptodactylidae	<i>Leptodactylus wagneri</i>		LC	Non-described	de Carvalho <i>et al.</i> (2022)
Leptodactylidae	<i>Lithodytes lineatus</i>		LC	Regös and Schlüter (1984); Lamar and Wild (1995); Schlüter and Regos (1996); Hero (1990)	Marquez <i>et al.</i> (1995); Schlüter <i>et al.</i> (2009)
Phyllomedusidae	<i>Agalychnis buckleyi</i>		VU	Cannatella (1980)	Non-described
Phyllomedusidae	<i>Agalychnis hulli</i>		LC	Gray and Coloma (2022)	Non-described
Phyllomedusidae	<i>Agalychnis psilopygion</i>		EN	Cannatella (1980)	Cannatella (1980)
Phyllomedusidae	<i>Agalychnis spurrelli</i>		LC	Vargas-Salinas and Gutiérrez-Cárdenas (2005)	Ortega-Andrade (2008); Cossio and Medina-Barcenas (2020)
Phyllomedusidae	<i>Callimedusa ecuatoriana</i>	E	EN	Brito <i>et al.</i> (2014)	Brito <i>et al.</i> (2014)
Phyllomedusidae	<i>Callimedusa perinesos</i>		CR	Non-described	Non-described
Phyllomedusidae	<i>Callimedusa tomopterna</i>		LC	Duellman (1978); Schiesari <i>et al.</i> (2022)	Zimmerman (1983); Duellman (2005)
Phyllomedusidae	<i>Cruziohyla calcarifer</i>		NT	Gray <i>et al.</i> (2021)	Non-described
Phyllomedusidae	<i>Cruziohyla craspedopus</i>		LC	Hoogmoed and Cadle (1990)	Non-described
Phyllomedusidae	<i>Phyllomedusa tarsius</i>		LC	Duellman (1978); Hero (1990); Schiesari <i>et al.</i> (2022)	Duellman (1978)
Phyllomedusidae	<i>Phyllomedusa vaillantii</i>		LC	Duellman (1978); Hero (1990); Wild (1996); Schiesari <i>et al.</i> (2022)	Duellman (1978, 2005); Röhr <i>et al.</i> (2020)
Phyllomedusidae	<i>Pithecopus palliatus</i>		EN	Duellman (1978)	Duellman (1978, 2005)
*Plethodontidae	<i>Bolitoglossa chica</i>		CR	N/A	N/A
*Plethodontidae	<i>Bolitoglossa ecuatoriana</i>	E	LC	N/A	N/A
*Plethodontidae	<i>Bolitoglossa medemi</i>		EN	N/A	N/A
*Plethodontidae	<i>Bolitoglossa palmata</i>	E	CR	N/A	N/A
*Plethodontidae	<i>Bolitoglossa sima</i>		EN	N/A	N/A
*Plethodontidae	<i>Oedipina ecuatoriana</i>	E	CR	N/A	N/A
*Plethodontidae	<i>Oedipina villamizariorum</i>	E	CR	N/A	N/A
**Caeciliidae	<i>Caecilia abitaguae</i>	E	EN	N/A	N/A
**Caeciliidae	<i>Caecilia albiventris</i>		DD	N/A	N/A
**Caeciliidae	<i>Caecilia attenuata</i>		DD	N/A	N/A
**Caeciliidae	<i>Caecilia bokermanni</i>	E	DD	N/A	N/A
**Caeciliidae	<i>Caecilia buckleyi</i>	E	DD	N/A	N/A
**Caeciliidae	<i>Caecilia crassisquama</i>	E	DD	N/A	N/A
**Caeciliidae	<i>Caecilia disossea</i>		LC	N/A	N/A

(Continued)

TABLE 0.2 (Continued)

Summary of Endemism, Red List Categories, and Citations of References for Which Tadpole and Call Descriptions of 655 Amphibians from Ecuador Have Been Published.

Family	Species	End	Rel List	Tadpole References	Call References
**Caeciliidae	<i>Caecilia dunnii</i>		CR	N/A	N/A
**Caeciliidae	<i>Caecilia guntheri</i>		EN	N/A	N/A
**Caeciliidae	<i>Caecilia leucocephala</i>		VU	N/A	N/A
**Caeciliidae	<i>Caecilia nigricans</i>		VU	N/A	N/A
**Caeciliidae	<i>Caecilia orientalis</i>		VU	N/A	N/A
**Caeciliidae	<i>Caecilia pachynema</i>	E	EN	N/A	N/A
**Caeciliidae	<i>Caecilia subterminalis</i>	E	DD	N/A	N/A
**Caeciliidae	<i>Caecilia tentaculata</i>		LC	N/A	N/A
**Caeciliidae	<i>Caecilia tenuissima</i>	E	DD	N/A	N/A
**Caeciliidae	<i>Osgaecilia bassleri</i>		VU	N/A	N/A
**Caeciliidae	<i>Osgaecilia equatorialis</i>	E	EN	N/A	N/A
**Rhinatrematidae	<i>Amazops amazops</i>	E	DD	Non-described	N/A
**Rhinatrematidae	<i>Epicrionops bicolor</i>		VU	Non-described	N/A
**Rhinatrematidae	<i>Epicrionops petersi</i>		EN	Non-described	N/A
**Siphonopidae	<i>Microcaecilia albiceps</i>		VU	N/A	N/A
**Siphonopidae	<i>Siphonops annulatus</i>		LC	N/A	N/A
**Typhlonectidae	<i>Chthonerpeton onorei</i>	E	DD	Non-described	N/A
**Typhlonectidae	<i>Potomotyphlus kaupii</i>		VU	Non-described	N/A

Note: Call descriptions are the ones that include quantitative data. For descriptions of tadpoles see accounts. Information on calls is given under accounts and in the section Vocalizations of Ecuadorian anurans. End = endemism, E = endemic, CR = Critically Endangered, CR (PE) = Critically Endangered, Possibly Extinct, EN = Endangered, DD = Data Deficient, LC = Least Concern, NT = Near Threatened, VU = Vulnerable. * = Caudata, ** = Gymnophiona.

TABLE 0.3**Ecuadorian Ecosystems *sensu* Ministerio del Ambiente del Ecuador (2013) and the Abbreviations Used Herein**

Ecosystem	Abbreviation
Deciduous Forest of Cordillera Costera of Ecuatorial Pacific	DFCCEP
Deciduous Forest of Lowlands of Jama-Zapotillo	DFLJZ
Deciduous Low Montane Forest of Catamayo-Alamor	DLMFCA
Deciduous Montane Foothill Forest of Catamayo-Alamor	DMFFCA
Deciduous Shrub and Grasslands of Beaches of Litoral	DSGBL
Desert Shrub of Lowlands of Jama-Zapotillo	DSLJZ
Desert Shrub of South of the Valleys	DSSV
Evergreen Forest of Lowlands of Aguarico-Putumayo-Caquetá	EFLAPC
Evergreen Forest of Lowlands with Bamboo of Amazonia	EFLBA
Evergreen Forest of Lowlands of Ecuatorial Chocó	EFLEC
Evergreen Forest of Lowlands of Fan of Pastaza	EFLFP
Evergreen Forest of Lowlands of Napo-Curaray	EFLNC
Evergreen Forest of Lowlands of Tigre-Pastaza	EFLTP
Evergreen Forest of Páramo	EFP
Evergreen Forest on Sandstone Plateaus of Cordillera del Cóndor in Lowland Ecuadorian Amazonia	EFSPCCLEA
Evergreen Grassland and Shrub of Páramo of Volcán Sumaco	EGSPVS
Evergreen High Montane Forest of Catamayo-Alamor	EHMFCFA
Evergreen High Montane Forest of Cordillera Occidental of the Andes	EHMFCOA
Evergreen High Montane Forest of North of Cordillera Oriental of the Andes	EHMFNCOA
Evergreen High Montane Forest of South of Cordillera Oriental of the Andes	EHMFSCOA
Evergreen Low Montane Forest of Catamayo-Alamor	ELMFCA
Evergreen Low Montane Forest of Cordilleras Cóndor-Kutukú	ELMFCKK
Evergreen Low Montane Forest of Cordillera Occidental of the Andes	ELMFCOA
Evergreen Low Montane Forest of Galeras	ELMFG
Evergreen Low Montane Forest of North of Cordillera Oriental of the Andes	ELMFNCOA
Evergreen Low Montane Forest of Cordillera Costera of Ecuatorial Chocó	ELMFCCEC
Evergreen Low Montane Forest of South of Cordillera Oriental of the Andes	ELMFSCOA
Evergreen Low Montane Forest on Sandstone Plateaus of Cordilleras Cóndor-Kutukú	ELMFSPCKK
Evergreen Montane Forest of Cordilleras Cóndor-Kutukú	EMCCCK
Evergreen Montane Forest of Catamayo-Alamor	EMFCA
Evergreen Montane Forest of Cordillera Occidental of the Andes	EMFCOA
Evergreen Montane Foothill Forest of Catamayo-Alamor	EMFFCA
Evergreen Montane Foothill Forest of Cordilleras Cóndor-Kutukú	EMFFCKK
Evergreen Montane Foothill Forest of Cordillera Occidental of the Andes	EMFFCOA
Evergreen Montane Foothill Forest of Galeras	EMFFG
Evergreen Montane Foothill Forest of North of Cordillera Oriental of the Andes	EMFFNCOA
Evergreen Montane Foothill Forest on Outcrops of Limestone Rock of Amazonian Cordilleras	EMFFOLRAC
Evergreen Montane Foothill Forest of South of Cordillera Oriental of the Andes	EMFFSCOA
Evergreen Montane Foothill Forest on Sandstone Plateaus of Cordilleras Cóndor-Kutukú	EMFFSPCKK
Evergreen Montane Forest of North of the Cordillera Oriental of the Andes	EMFNCOA
Evergreen Montane Forest of South of the Cordillera Oriental of the Andes	EMFSCOA
Evergreen Montane Forest on Sandstone Plateaus of Cordillera del Cóndor	EMFSPCC
Evergreen Montane Shrub from North of the Andes	EMSNA
Evergreen Montane Shrub from South of the Andes	EMSSA
Evergreen Riparian Shrub from Cordillera Oriental of the Andes	ERSCOA
Evergreen Seasonal Flooded Forest of Alluvial Plain Jama-Zapotillo	ESFFAPJZ
Evergreen Seasonal Forest of Lowlands of Ecuatorial Chocó	ESFLEC
Evergreen Seasonal Forest of Lowlands of Jama-Zapotillo	ESFLJZ
Evergreen Shrub and Grassland of Páramo	ESGP
Evergreen Subnivarean Grassland and Shrub of Páramo	ESGSP
Evergreen Seasonal Low Montane Forest of Catamayo-Alamor	ESLMFCA

(Continued)

TABLE 0.3 (Continued)**Ecuadorian Ecosystems *sensu* Ministerio del Ambiente del Ecuador (2013) and the Abbreviations Used Herein**

Ecosystem	Abbreviation
Evergreen Seasonal Low Montane Forest of Cordillera Costera of Ecuatorial Pacific	ESLMFCCEP
Evergreen Seasonal Montane Foothill Forest of Catamayo-Alamor	ESMFFCA
Evergreen Seasonal Montane Foothill Forest of Cordillera Costera of Ecuatorial Chocó	ESMFFCCEC
Evergreen Seasonal Montane Foothill Forest of Cordillera Costera of Ecuatorial Pacific	ESMFFCCEP
Evergreen Seasonal Montane Foothill Forest of Cordillera Occidental of the Andes	ESMFFCOA
Evergreen Shrub and Montane Grassland of Cordillera del Cóndor	ESMGCC
Evergreen High Montane Shrub from Southern Páramo	EHMSSP
Flooded Forest of Alluvial Plain of Amazonia	FFAPA
Flooded Forest of Alluvial Plain of Ecuatorial Chocó	FFAPEC
Flooded Forest of Alluvial Plain of Rivers of Andean and Amazonian Cordilleras Origin	FFAPRAAC
Flooded Forest of Alluvial Plain of Rivers of Amazonian Origin	FFAPRAO
Flooded Forest of Intertidal Plain of Ecuatorial Chocó	FFIPEC
Flooded Forest and Lacustrine-riparian Vegetation of Amazonian Black Waters	FFLVABW
Flooded Forest of Palms of Alluvial Plain of Amazonia	FFPAPA
Flooded Grassland of Páramo	FGP
Flooded Lacustrine-riparian of the Alluvial Plain of Amazonia	FLAPA
Flooded Lacustrine Grassland of Ecuatorial Pacific	FLGEP
Flooded Riparian Grassland of Lowlands of Ecuatorial Chocó	FRGLEC
Flooded Riparian Grassland of Lowlands of Jama-Zapotillo	FRGLJZ
Forest and Semideciduous Shrub of North of the Valleys	FSSNV
Forest and Semideciduous Shrub of South of the Valleys	FSSSV
Grassland of Páramo	GP
High Superior Humid Montane Grassland of Páramo	HSHMGP
Low Forest and Deciduous Shrub of Lowlands of Jama-Zapotillo	LFDLSJZ
Low Montane Lacustrine Grassland of South of Cordillera Oriental of the Andes	LMLGSCOA
Mangrove of Ecuatorial Chocó	MEC
Mangrove of Jama-Zapotillo	MJZ
Rosette Caulescent and Grassland of Páramo (Frailejones)	RCGP
Semideciduous Forest of Cordillera Costera of Ecuatorial Pacific	SFCCEP
Semideciduous Forest of Lowlands of Jama-Zapotillo	SFLJZ
Semideciduous Low Montane Forest of Catamayo-Alamor	SLMFCA
Semideciduous Montane Foothill Forest of Catamayo-Alamor	SMFFCA
Semideciduous Montane Foothill Forest of South of Cordillera Oriental of the Andes	SMFFSCOA
Semideciduous Shrub of South of the Valleys	SSSV
Subnivarean Humid Grassland of Páramo	SHGP
Ultra Humid Subnivarean Grassland of Páramo	UHS GP

TABLE 0.4

Distribution of 655 Species of Ecuadorian Amphibians in 89 Ecosystems (*sensu* Ministerio del Ambiente del Ecuador, 2013).

Centrolenidae	<i>Centrolene ballux</i>	ELMFCOA, EMFCOA
Centrolenidae	<i>Centrolene buckleyi</i>	EMSNA, ESGP, EHMFCOA, ELMFCOA, ELMFNCOA, ELMFSCOA, EMFCOA, EMFNCOA, RCGP
Centrolenidae	<i>Centrolene charapita</i>	EMFFOLRAC
Centrolenidae	<i>Centrolene condor</i>	EMCCCK, EMFSPCC
Centrolenidae	<i>Centrolene geckoidea</i>	ELMFCOA, EMFCOA
Centrolenidae	<i>Centrolene heloderma</i>	ELMFCOA, EMFCOA
Centrolenidae	<i>Centrolene huilensis</i>	I
Centrolenidae	<i>Centrolene lynchi</i>	ELMFCOA, EMFCOA
Centrolenidae	<i>Centrolene medemi</i>	ELMFNCOA
Centrolenidae	<i>Centrolene peristicta</i>	ELMFCOA, EMFCOA
Centrolenidae	<i>Centrolene pipilata</i>	ELMFNCOA
Centrolenidae	<i>Centrolene sanchezi</i>	ELMFNCOA, EMFNCOA
Centrolenidae	<i>Chimerella mariaelenae</i>	ERSCOA, EFLFP, ELMFCCK, ELMFNCOA, ELMFSCOA, EMFFNCOA
Centrolenidae	<i>Cochranella granulosa</i>	EFLEC
Centrolenidae	<i>Cochranella litoralis</i>	EFLEC
Centrolenidae	<i>Cochranella mache</i>	EFLEC, ESFLJZ, ESMFFCCEC, ELMFCCEC, EMFFCOA
Centrolenidae	<i>Cochranella resplendens</i>	FFAPA, EFLAPC, EFLNC, EFLTP, EMFFNCOA
Centrolenidae	<i>Espadarana audax</i>	ELMFNCOA, ELMFSCOA, EMFNCOA, EMFFCCK, EMFFNCOA
Centrolenidae	<i>Espadarana callistomma</i>	EFLEC, EMFFCOA
Centrolenidae	<i>Espadarana durrellorum</i>	EFLNC, ELMFNCOA, EMFFSCOA
Centrolenidae	<i>Espadarana prosoblepon</i>	FFAPEC, SFCCEP, EFLEC, ESMFFCCEC, ESMFFCA, ELMFCCEC, ELMFCOA, EMFFCOA
Centrolenidae	<i>Hyalinobatrachium adespinosai</i>	ELMFNCOA
Centrolenidae	<i>Hyalinobatrachium aureoguttatum</i>	EFLEC
Centrolenidae	<i>Hyalinobatrachium chirripoi</i>	EFLEC, EMFFCOA
Centrolenidae	<i>Hyalinobatrachium iaspidiense</i>	EFLAPC, EFLNC, EMFFNCOA
Centrolenidae	<i>Hyalinobatrachium mashpi</i>	EMFFCOA
Centrolenidae	<i>Hyalinobatrachium munozorum</i>	FFAPA, EFLAPC, EFLNC, EMFFNCOA
Centrolenidae	<i>Hyalinobatrachium nouns</i>	EMFFCOA
Centrolenidae	<i>Hyalinobatrachium pellucidum</i>	ELMFNCOA, EMFNCOA, EMFFCCK, EMFFSCOA
Centrolenidae	<i>Hyalinobatrachium tatayoi</i>	EFLEC, ESFLJZ, ESLMFCCEP, ELMFCOA, MEC
Centrolenidae	<i>Hyalinobatrachium valerioi</i>	I
Centrolenidae	<i>Hyalinobatrachium yaku</i>	EFLTP, EMFFNCOA
Centrolenidae	<i>Nymphargus anomalus</i>	ELMFNCOA, ELMFSCOA
Centrolenidae	<i>Nymphargus balionotus</i>	ELMFCOA, EMFFCOA
Centrolenidae	<i>Nymphargus buenaventura</i>	ESMFFCOA, ESMFFCA
Centrolenidae	<i>Nymphargus cariticommatu</i>	ELMFSCOA, EMFSCOA
Centrolenidae	<i>Nymphargus cochranae</i>	ELMFCCCK, ELMFNCOA, EMCCCK, EMFFCCK, EMFFNCOA, EMFFSCOA
Centrolenidae	<i>Nymphargus colomai</i>	EMFFOLRAC
Centrolenidae	<i>Nymphargus garciae</i>	EMFNCOA
Centrolenidae	<i>Nymphargus grandisonae</i>	ELMFCOA, EMFCOA
Centrolenidae	<i>Nymphargus griffithsi</i>	ELMFCOA, EMFCOA
Centrolenidae	<i>Nymphargus humboldti</i>	ELMFCCCK, ELMFNCOA
Centrolenidae	<i>Nymphargus lasgralarias</i>	ELMFCOA, EMFCOA
Centrolenidae	<i>Nymphargus laurae</i>	ELMFNCOA
Centrolenidae	<i>Nymphargus lindae</i>	EMFFOLRAC
Centrolenidae	<i>Nymphargus manduriacu</i>	EMFFCOA
Centrolenidae	<i>Nymphargus mariae</i>	EFLTP, EMFFNCOA
Centrolenidae	<i>Nymphargus megacheirus</i>	ELMFNCOA
Centrolenidae	<i>Nymphargus megista</i>	ELMFCOA

(Continued)

TABLE 0.4 (Continued)

Distribution of 655 Species of Ecuadorian Amphibians in 89 Ecosystems (*sensu* Ministerio del Ambiente del Ecuador, 2013).

Centrolenidae	<i>Nymphargus posadae</i>	ELMFNCOA, ELMFSCOA, EMFNCOA, EMFFSCOA
Centrolenidae	<i>Nymphargus siren</i>	ELMFNCOA, EMFNCOA
Centrolenidae	<i>Nymphargus sucre</i>	EMFSCOA
Centrolenidae	<i>Nymphargus wileyi</i>	ELMFNCOA, EMFNCOA
Centrolenidae	<i>Rulyrana flavopunctata</i>	EFLFP, ELMFNCOA, EMFNCOA, EMFFNCOA
Centrolenidae	<i>Rulyrana mcdiarmidi</i>	SMFFSCOA, EFLFP, ELMFCCK, EMFFCCK, EMFFSCOA, EMFFOLRAC
Centrolenidae	<i>Sachatamia albomaculata</i>	EFLEC, ELMFCCEC, ELMFCOA, EMFFCOA
Centrolenidae	<i>Sachatamia ilex</i>	EFLEC, EMFFCOA
Centrolenidae	<i>Sachatamia orejuela</i>	EMFFCOA
Centrolenidae	<i>Teratohyla ameliae</i>	EFLNC, EFLTP, EMFFCCK, EMFFNCOA, EMFFOLRAC
Centrolenidae	<i>Teratohyla midas</i>	FFAPRAAC, FFAPA, EFLFP, EFLAPC, EFLNC, EFLTP, EMFFCCK, EMFFNCOA
Centrolenidae	<i>Teratohyla pulverata</i>	EFLEC
Centrolenidae	<i>Teratohyla spinosa</i>	EFLEC, EMFFCOA
Centrolenidae	<i>Vitreorana ritae</i>	FFAPA, EFLNC
Ceratophryidae	<i>Ceratophrys cornuta</i>	FFAPA, EFLAPC, EFLNC
Ceratophryidae	<i>Ceratophrys stolzmanni</i>	LFDSLJZ, DFLJZ, SFCCEP, ESMFFCCEP
Eleutherodactylidae	<i>Adelophryne adiastrata</i>	FFAPA, EFLTP
Eleutherodactylidae	<i>Diasporus gularis</i>	EFLEC, EMFFCOA
Hemiphractidae	<i>Gastrotheca andaquiensis</i>	ELMFCCCK, ELMFNCOA, EMFFCCK, EMFFNCOA
Hemiphractidae	<i>Gastrotheca angustifrons</i>	EFLEC
Hemiphractidae	<i>Gastrotheca cornuta</i>	EFLEC, EMFFCOA
Hemiphractidae	<i>Gastrotheca cuencana</i>	EHMFCOA
Hemiphractidae	<i>Gastrotheca dendronastes</i>	I
Hemiphractidae	<i>Gastrotheca eliciei</i>	EMSSA, EHMFCOA, EMFSCOA
Hemiphractidae	<i>Gastrotheca espeletia</i>	RCGP
Hemiphractidae	<i>Gastrotheca guentheri</i>	ELMFNCOA, EMFCOA, EMFFCOA
Hemiphractidae	<i>Gastrotheca litonensis</i>	EMFCOA
Hemiphractidae	<i>Gastrotheca lojana</i>	EMSSA, EMFCA, GP
Hemiphractidae	<i>Gastrotheca longipes</i>	FFAPRAAC, FFAPA, FFPAPA, EFLFP, EFLNC, EFLTP, EMFFCCK, EMFFNCOA
Hemiphractidae	<i>Gastrotheca orophylax</i>	EHMFCOA, EMFNCOA
Hemiphractidae	<i>Gastrotheca plumbea</i>	EHMFCOA, ELMFCOA, EMFCOA
Hemiphractidae	<i>Gastrotheca pseustes</i>	EMSNA, ESGP, EHMFCOA, EHMFCOA, EHMFCOA, EMFCOA, GP, HSHMGP, UHSGP, ESGSP
Hemiphractidae	<i>Gastrotheca psychrophila</i>	I
Hemiphractidae	<i>Gastrotheca riobambae</i>	EMSNA, ESGP, EHMFCOA, EMFCOA, FSSNV, GP
Hemiphractidae	<i>Gastrotheca testudinea</i>	ELMFCCCK, ELMFNCOA, EMFNCOA, EMFSCOA, EMFFCCK, EMFFNCOA
Hemiphractidae	<i>Gastrotheca turnerorum</i>	ESGP, EHMFCOA, EMFCA, FGP
Hemiphractidae	<i>Gastrotheca weinlandii</i>	ELMFCCCK, ELMFNCOA, ELMFCOA, EMFSCOA, EMFFCCK, EMFFSCOA
Hemiphractidae	<i>Gastrotheca yacuri</i>	EMFCA
Hemiphractidae	<i>Hemiphractus bubalus</i>	ELMFNCOA, EMFNCOA, EMFFNCOA
Hemiphractidae	<i>Hemiphractus fasciatus</i>	I
Hemiphractidae	<i>Hemiphractus helioi</i>	I
Hemiphractidae	<i>Hemiphractus proboscideus</i>	FFAPRAAC, FFAPA, FFPAPA, EFLNC, EFLTP, EMFFCCK
Hemiphractidae	<i>Hemiphractus scutatus</i>	FFAPRAAC, FFAPA, EFLFP, EFLNC, EFLTP, ELMFCCK, ELMFNCOA, ELMFCCK, EMFFNCOA
Leptodactylidae	<i>Adenomera andreae</i>	FFAPRAO, FFAPRAAC, FFLVABW, FFAPA, FFPAPA, EFLFP, EFLAPC, EFLNC, ELMFNCOA, EMFFCCK, EMFFNCOA, EMFFSCOA, FLAPA
Leptodactylidae	<i>Adenomera hylaedactyla</i>	FFAPRAO, FFAPA, EFLNC, EFLTP, EHMFCOA, ELMFNCOA, EMFNCOA, EMFFNCOA, EMFFOLRAC
Leptodactylidae	<i>Edalorhina perezi</i>	FFAPRAO, FFAPRAAC, FFAPA, FFPAPA, EFLFP, EFLNC, EFLTP, EMFNCOA,
Leptodactylidae	<i>Engystomops coloradorum</i>	EMFFCOA

TABLE 0.4 (Continued)

Distribution of 655 Species of Ecuadorian Amphibians in 89 Ecosystems (*sensu* Ministerio del Ambiente del Ecuador, 2013).

Leptodactylidae	<i>Engystomops guayaco</i>	DFLJZ, SFLJZ
Leptodactylidae	<i>Engystomops montubio</i>	LFDSLJZ, DFCCEP, SFLJZ, ESFLJZ
Leptodactylidae	<i>Engystomops petersi</i>	FFAPRAO, FFAPRAAC, FFLVABW, FFAPA, FFPAPA, EFLFP, EFLAPC, EFLNC, EMFFCCK, EMFFNCOA
Leptodactylidae	<i>Engystomops pustulatus</i>	DSGBL, LFDSLJZ, DFLJZ, SFLJZ, ESFLJZ, ESMFFCCEP
Leptodactylidae	<i>Engystomops puyango</i>	SSSV, LFDSLJZ, DFLJZ, DMFFCA, SLMFCA, SMFFCA, ESMFFCA
Leptodactylidae	<i>Engystomops randi</i>	LFDSLJZ, DFLJZ, ESFLJZ, ESMFFCA
Leptodactylidae	<i>Leptodactylus discodactylus</i>	FFAPRAO, FFAPRAAC, FFAPA, FFPAPA, EFLFP, EFLAPC, EFLNC, EFLTP, FLAPA
Leptodactylidae	<i>Leptodactylus knudseni</i>	FFAPRAO, FFAPA, EFLAPC, EFLNC, EFLTP, EMFFOLRAC
Leptodactylidae	<i>Leptodactylus labrosus</i>	SSSV, LFDSLJZ, DFCCEP, DFLJZ, DMFFCA, SFLJZ, SLMFCA, SMFFCA, ESFLEC, ESFLJZ, ESMFFCCEP, ESMFFCA, ELMFCCEC, EMFFCOA, MEC
Leptodactylidae	<i>Leptodactylus leptodactyloides</i>	FFAPRAAC, FFPAPA, EFLFP, EFLAPC, EFLNC, ELMFCCK, EMFFCCK, MEC
Leptodactylidae	<i>Leptodactylus melanonotus</i>	EFLEC
Leptodactylidae	<i>Leptodactylus mystaceus</i>	FFAPRAO, FFAPRAAC, FFAPA, FFPAPA, EFLFP, EFLAPC, EFLNC, EMFFNCOA
Leptodactylidae	<i>Leptodactylus pentadactylus</i>	FFAPRAO, FFAPRAAC, FFLVABW, FFAPA, FFPAPA, EFLFP, EFLAPC, EFLNC, EMFFG, EMFFNCOA, EMFFOLRAC
Leptodactylidae	<i>Leptodactylus peritoaktites</i>	ESFLJZ
Leptodactylidae	<i>Leptodactylus petersii</i>	FFAPA, EFLFP, EFLAPC
Leptodactylidae	<i>Leptodactylus rhodomerus</i>	EFLEC, ESMFFCCEC, ELMFCCEC
Leptodactylidae	<i>Leptodactylus rhodomystax</i>	FFAPRAO, FFAPRAAC, FFAPA, FFPAPA, EFLFP, EFLAPC, EFLNC, EFLTP, EMFFNCOA
Leptodactylidae	<i>Leptodactylus stenodema</i>	FFAPA, FFPAPA, EFLNC, EFLTP, ELMFNCOA
Leptodactylidae	<i>Leptodactylus ventrimaculatus</i>	DFLJZ, SFCCEP, SFLJZ, EFLEC, ESFLJZ, ESLMFCCEP, ELMFCCEC, ELMFCOA,
Leptodactylidae	<i>Leptodactylus wagneri</i>	ERSCOA, FFAPRAO, FFAPRAAC, FFAPA, FFPAPA, EFLFP, EFLAPC, EFLNC, ELMFCCK, ELMFNCOA, ELMFSCOA, ELMFSPCCK, EMFFCCK, EMFFNCOA, EMFFSCOA, EMFFOLRAC
Leptodactylidae	<i>Lithodytes lineatus</i>	FFAPRAO, FFAPRAAC, FFLVABW, FFAPA, FFPAPA, EFLFP, EFLAPC, EFLNC, ELMFCCK, EMFFG, EMFFCCK, EMFFNCOA, EMFFSCOA, EMFFOLRAC, EMFFSPCCK, FLAPA
Phyllomedusidae	<i>Agalychnis buckleyi</i>	ELMFNCOA
Phyllomedusidae	<i>Agalychnis hulli</i>	FFAPRAO, EFLFP, EFLNC, EFLTP, EMFFCCK, EMFFNCOA, EMFFOLRAC
Phyllomedusidae	<i>Agalychnis psilopygion</i>	EFLEC, ESFLJZ
Phyllomedusidae	<i>Agalychnis spurrelli</i>	SFLJZ, EFLEC, ESMFFCCEP, ESMFFCA, ELMFCCEC, EMFFCOA
Phyllomedusidae	<i>Callimedusa ecuatoriana</i>	ELMFCCK, ELMFSPCCK, EMCCCK, EMFSPCC, EMFFSCOA
Phyllomedusidae	<i>Callimedusa perinesos</i>	ELMFNCOA
Phyllomedusidae	<i>Callimedusa tomopterna</i>	FFAPRAO, FFAPA, FFPAPA, EFLFP, EFLAPC, EFLNC, EFLTP, EMFFCCK, EMFFOLRAC
Phyllomedusidae	<i>Cruziohyla calcarifer</i>	EFLEC, EMFFCOA
Phyllomedusidae	<i>Cruziohyla craspedopus</i>	FFAPRAO, FFAPRAAC, FFLVABW, FFAPA, FFPAPA, EFLAPC, EFLNC, EFLTP, EMFFOLRAC
Phyllomedusidae	<i>Phyllomedusa tarsius</i>	FFAPRAAC, FFAPA, EFLFP, EFLAPC, EFLNC, EFLTP, EMFFCCK, EMFFNCOA,
Phyllomedusidae	<i>Phyllomedusa vaillantii</i>	FFAPRAO, FFAPRAAC, FFAPA, FFPAPA, EFLFP, EFLAPC, EFLNC, EFLTP, EMFFNCOA, EMFFOLRAC
Phyllomedusidae	<i>Pithecopus palliatus</i>	EFLAPC
*Plethodontidae	<i>Bolitoglossa chica</i>	FFAPEC, EFLEC, ESFLJZ, EMFFCOA
*Plethodontidae	<i>Bolitoglossa ecuatoriana</i>	FFAPRAO, FFLVABW, FFAPA, FFPAPA, EFLAPC, EFLNC, EMFFNCOA
*Plethodontidae	<i>Bolitoglossa medemi</i>	EFLEC, EMFCOA, EMFFCOA
*Plethodontidae	<i>Bolitoglossa palmata</i>	ELMFNCOA, EMFNCOA

(Continued)

TABLE 0.4 (Continued)

Distribution of 655 Species of Ecuadorian Amphibians in 89 Ecosystems (*sensu* Ministerio del Ambiente del Ecuador, 2013).

*Plethodontidae	<i>Bolitoglossa sima</i>	EFLEC, ELMFCCEC, EMFFCOA, MEC
*Plethodontidae	<i>Oedipina ecuatoriana</i>	I
*Plethodontidae	<i>Oedipina villamizariorum</i>	I
**Caeciliidae	<i>Caecilia abitaguae</i>	ELMFNCOA
**Caeciliidae	<i>Caecilia albiventris</i>	I
**Caeciliidae	<i>Caecilia attenuata</i>	I
**Caeciliidae	<i>Caecilia bokermanni</i>	FFAPRAAC
**Caeciliidae	<i>Caecilia buckleyi</i>	ELMFNCOA, EMFCOA
**Caeciliidae	<i>Caecilia crassisquama</i>	EMCCCK
**Caeciliidae	<i>Caecilia disossea</i>	FFAPRAAC, FFAPA, EFLNC, EFLTP, EMFFNCOA
**Caeciliidae	<i>Caecilia dunni</i>	I
**Caeciliidae	<i>Caecilia guntheri</i>	I
**Caeciliidae	<i>Caecilia leucocephala</i>	EFLEC, ESMFCCCEC, EMFFCOA
**Caeciliidae	<i>Caecilia nigricans</i>	EFLEC, ESFLJZ, ESLMFCCEP, ELMFCCEC, EMFFCOA
**Caeciliidae	<i>Caecilia orientalis</i>	ELMFNCOA, EMFNCOA, EMFFNCOA
**Caeciliidae	<i>Caecilia pachynema</i>	DSSV
**Caeciliidae	<i>Caecilia subterminalis</i>	I
**Caeciliidae	<i>Caecilia tentaculata</i>	FFAPA, EFLNC, EFLTP, EMFFNCOA
**Caeciliidae	<i>Caecilia tenuissima</i>	I
**Caeciliidae	<i>Osgoecia bassleri</i>	FFAPA, EMFFNCOA
**Caeciliidae	<i>Osgoecia equatorialis</i>	ESMFCCCEC, EMFFCOA
**Rhinatrematidae	<i>Amazops amazops</i>	I
**Rhinatrematidae	<i>Epicrionops bicolor</i>	ELMFNCOA
**Rhinatrematidae	<i>Epicrionops petersi</i>	ELMFNCOA, EMFNCOA
**Siphonopidae	<i>Microcaecilia albiceps</i>	FFAPA, EFLTP
**Siphonopidae	<i>Siphonops annulatus</i>	FFAPA, FFPAPA, EFLAPC, EFLNC, EFLTP, EMFFNCOA
**Typhlonectidae	<i>Chthonerpeton onorei</i>	ELMFNCOA
**Typhlonectidae	<i>Potomotyphlus kaupii</i>	FFAPRAAC

Note: Water (W) and intervened (I) areas are also included. * = Caudata, ** = Gymnophiona. Abbreviations are given in Table 0.3.

TABLE 0.5

Distribution of 655 Species of Ecuadorian Amphibians in 15 Biogeographic Sectors (*sensu* Ministerio del Ambiente del Ecuador, 2013).

Family	Species	AC	APC	CA	CCC	CCEP	COA	EC	FP	JZ	NC	NCOA	P	SCOA	TP	V	# sectors
Centrolenidae	<i>Centrolene ballux</i>						X										1
Centrolenidae	<i>Centrolene buckleyi</i>						X					X	X	X			4
Centrolenidae	<i>Centrolene charapita</i>	X															1
Centrolenidae	<i>Centrolene condor</i>	X															1
Centrolenidae	<i>Centrolene geckoidea</i>						X										1
Centrolenidae	<i>Centrolene heloderma</i>						X										1
Centrolenidae	<i>Centrolene huilensis</i>											X					1
Centrolenidae	<i>Centrolene lynchi</i>						X										1
Centrolenidae	<i>Centrolene medemi</i>											X					1
Centrolenidae	<i>Centrolene peristicta</i>						X										1
Centrolenidae	<i>Centrolene pipilata</i>											X					1
Centrolenidae	<i>Centrolene sanchezi</i>	X										X					2
Centrolenidae	<i>Chimerella mariaelenae</i>	X							X			X		X			4
Centrolenidae	<i>Cochranella granulosa</i>						X	X									2
Centrolenidae	<i>Cochranella litoralis</i>						X	X									2
Centrolenidae	<i>Cochranella mache</i>				X		X	X		X							4
Centrolenidae	<i>Cochranella resplendens</i>		X								X	X		X	X		5
Centrolenidae	<i>Espadarana audax</i>	X										X		X			3
Centrolenidae	<i>Espadarana callistomma</i>						X	X									2
Centrolenidae	<i>Espadarana durrellorum</i>	X									X	X		X			4
Centrolenidae	<i>Espadarana prosoblepon</i>			X	X	X	X	X		X							6
Centrolenidae	<i>Hyalinobatrachium adespinosai</i>											X					1
Centrolenidae	<i>Hyalinobatrachium aureoguttatum</i>						X	X									2
Centrolenidae	<i>Hyalinobatrachium chirripoi</i>						X	X		X							3
Centrolenidae	<i>Hyalinobatrachium iaspidiense</i>	X									X	X					3
Centrolenidae	<i>Hyalinobatrachium mashpi</i>						X										1
Centrolenidae	<i>Hyalinobatrachium munozorum</i>	X	X								X	X					4
Centrolenidae	<i>Hyalinobatrachium nouns</i>						X										1
Centrolenidae	<i>Hyalinobatrachium pellucidum</i>	X										X		X			3
Centrolenidae	<i>Hyalinobatrachium tatayoi</i>					X	X	X		X							4
Centrolenidae	<i>Hyalinobatrachium valerioi</i>																0
Centrolenidae	<i>Hyalinobatrachium yaku</i>										X	X			X		3
Centrolenidae	<i>Nymphargus anomalus</i>											X		X			2
Centrolenidae	<i>Nymphargus balionotus</i>						X										1

(Continued)

TABLE 0.5 (Continued)

Distribution of 655 Species of Ecuadorian Amphibians in 15 Biogeographic Sectors (*sensu* Ministerio del Ambiente del Ecuador, 2013).

Family	Species	AC	APC	CA	CCC	CCEP	COA	EC	FP	JZ	NC	NCOA	P	SCOA	TP	V	# sectors
Centrolenidae	<i>Nymphargus buenaventura</i>			X			X										2
Centrolenidae	<i>Nymphargus cariticommatus</i>													X			1
Centrolenidae	<i>Nymphargus cochranae</i>	X										X		X			3
Centrolenidae	<i>Nymphargus colomai</i>	X															1
Centrolenidae	<i>Nymphargus garciae</i>											X					1
Centrolenidae	<i>Nymphargus grandisonae</i>						X										1
Centrolenidae	<i>Nymphargus griffithsi</i>						X										1
Centrolenidae	<i>Nymphargus humboldti</i>	X										X					2
Centrolenidae	<i>Nymphargus lasgralarias</i>						X										1
Centrolenidae	<i>Nymphargus laurae</i>										X						1
Centrolenidae	<i>Nymphargus lindae</i>	X															1
Centrolenidae	<i>Nymphargus manduriacu</i>						X										1
Centrolenidae	<i>Nymphargus mariae</i>										X	X			X		3
Centrolenidae	<i>Nymphargus megacheirus</i>											X					1
Centrolenidae	<i>Nymphargus megista</i>						X										1
Centrolenidae	<i>Nymphargus posadae</i>											X		X			2
Centrolenidae	<i>Nymphargus siren</i>											X					1
Centrolenidae	<i>Nymphargus sucre</i>													X			1
Centrolenidae	<i>Nymphargus wileyi</i>											X					1
Centrolenidae	<i>Rulyrana flavopunctata</i>								X		X	X					3
Centrolenidae	<i>Rulyrana mcdiarmidi</i>	X							X					X			3
Centrolenidae	<i>Sachatamia albomaculata</i>				X		X	X									3
Centrolenidae	<i>Sachatamia ilex</i>						X	X									2
Centrolenidae	<i>Sachatamia orejuela</i>						X										1
Centrolenidae	<i>Teratohyla amelie</i>	X									X	X			X		4
Centrolenidae	<i>Teratohyla midas</i>	X	X						X		X	X			X		6
Centrolenidae	<i>Teratohyla pulverata</i>						X	X									2
Centrolenidae	<i>Teratohyla spinosa</i>						X	X									2
Centrolenidae	<i>Vitreorana ritae</i>		X								X						2
Ceratophryidae	<i>Ceratophrys cornuta</i>		X								X			X	X		4
Ceratophryidae	<i>Ceratophrys stolzmanni</i>					X				X							2
Eleutherodactylidae	<i>Adelophryne adiastrata</i>														X		1
Eleutherodactylidae	<i>Diasporus gularis</i>						X	X									2
Hemiphractidae	<i>Gastrotheca andaquiensis</i>	X															1
Hemiphractidae	<i>Gastrotheca angustifrons</i>							X									1
Hemiphractidae	<i>Gastrotheca cornuta</i>						X	X		X							3

TABLE 0.5 (Continued)

Distribution of 655 Species of Ecuadorian Amphibians in 15 Biogeographic Sectors (*sensu* Ministerio del Ambiente del Ecuador, 2013).

Family	Species	AC	APC	CA	CCC	CCEP	COA	EC	FP	JZ	NC	NCOA	P	SCOA	TP	V	# sectors
Hemiphractidae	<i>Gastrotheca cuencana</i>						X						X	X			3
Hemiphractidae	<i>Gastrotheca dendronastes</i>						X										1
Hemiphractidae	<i>Gastrotheca eliciei</i>			X									X	X			3
Hemiphractidae	<i>Gastrotheca espeletia</i>						X					X	X				3
Hemiphractidae	<i>Gastrotheca guentheri</i>						X										1
Hemiphractidae	<i>Gastrotheca litonedis</i>						X										1
Hemiphractidae	<i>Gastrotheca lojana</i>			X			X						X			X	4
Hemiphractidae	<i>Gastrotheca longipes</i>	X	X						X		X	X			X		6
Hemiphractidae	<i>Gastrotheca orophylax</i>											X					1
Hemiphractidae	<i>Gastrotheca plumbea</i>						X					X					2
Hemiphractidae	<i>Gastrotheca pseustes</i>			X			X					X	X	X		X	6
Hemiphractidae	<i>Gastrotheca psychrophila</i>													X			1
Hemiphractidae	<i>Gastrotheca riobambae</i>						X					X	X			X	4
Hemiphractidae	<i>Gastrotheca testudinea</i>	X									X	X		X			4
Hemiphractidae	<i>Gastrotheca turnerorum</i>												X				1
Hemiphractidae	<i>Gastrotheca weinlandii</i>	X										X		X			3
Hemiphractidae	<i>Gastrotheca yacuri</i>												X				1
Hemiphractidae	<i>Hemiphractus bubalus</i>											X		X			2
Hemiphractidae	<i>Hemiphractus fasciatus</i>						X										1
Hemiphractidae	<i>Hemiphractus helioi</i>											X					1
Hemiphractidae	<i>Hemiphractus proboscideus</i>	X	X								X				X		4
Hemiphractidae	<i>Hemiphractus scutatus</i>	X	X						X		X	X			X		6
Leptodactylidae	<i>Adenomera andreae</i>	X	X						X		X	X		X	X		7
Leptodactylidae	<i>Adenomera hylaedactyla</i>	X	X								X	X	X	X	X		7
Leptodactylidae	<i>Edalorhina perezii</i>		X						X		X	X			X		5
Leptodactylidae	<i>Engystomops coloradorum</i>						X										1
Leptodactylidae	<i>Engystomops guayaco</i>							X		X							2
Leptodactylidae	<i>Engystomops montubio</i>					X				X							2
Leptodactylidae	<i>Engystomops petersi</i>	X	X						X		X	X		X	X		7
Leptodactylidae	<i>Engystomops pustulatus</i>			X	X	X		X		X							5
Leptodactylidae	<i>Engystomops puyango</i>			X						X						X	3
Leptodactylidae	<i>Engystomops randi</i>			X						X							2
Leptodactylidae	<i>Leptodactylus discodactylus</i>	X	X						X		X	X			X		6
Leptodactylidae	<i>Leptodactylus knudseni</i>	X	X								X	X		X	X		6

(Continued)

TABLE 0.5 (Continued)

Distribution of 655 Species of Ecuadorian Amphibians in 15 Biogeographic Sectors (*sensu* Ministerio del Ambiente del Ecuador, 2013).

Family	Species	AC	APC	CA	CCC	CCEP	COA	EC	FP	JZ	NC	NCOA	P	SCOA	TP	V	# sectors
Leptodactylidae	<i>Leptodactylus labrosus</i>			X	X	X	X	X		X						X	7
Leptodactylidae	<i>Leptodactylus leptodactyloides</i>	X	X						X		X				X		5
Leptodactylidae	<i>Leptodactylus melanonotus</i>							X		X							2
Leptodactylidae	<i>Leptodactylus mystaceus</i>		X						X		X	X			X		5
Leptodactylidae	<i>Leptodactylus pentadactylus</i>	X	X						X		X	X			X		6
Leptodactylidae	<i>Leptodactylus peritoaktites</i>						X	X		X							3
Leptodactylidae	<i>Leptodactylus petersii</i>		X						X						X		3
Leptodactylidae	<i>Leptodactylus rhodomerus</i>				X		X	X									3
Leptodactylidae	<i>Leptodactylus rhodomystax</i>		X						X		X	X			X		5
Leptodactylidae	<i>Leptodactylus stenodema</i>		X						X		X	X			X		5
Leptodactylidae	<i>Leptodactylus ventrimaculatus</i>				X	X	X	X		X							5
Leptodactylidae	<i>Leptodactylus wagneri</i>	X	X						X		X	X		X	X		7
Leptodactylidae	<i>Lithodytes lineatus</i>	X	X						X		X	X		X	X		7
Phyllomedusidae	<i>Agalychnis buckleyi</i>											X					1
Phyllomedusidae	<i>Agalychnis hulli</i>	X	X						X		X	X			X		6
Phyllomedusidae	<i>Agalychnis psilopygion</i>							X		X							2
Phyllomedusidae	<i>Agalychnis spurrelli</i>			X	X	X	X	X		X							6
Phyllomedusidae	<i>Callimedusa ecuatoriana</i>	X												X			2
Phyllomedusidae	<i>Callimedusa perinesos</i>											X					1
Phyllomedusidae	<i>Callimedusa tomopterna</i>	X	X						X		X	X		X	X		7
Phyllomedusidae	<i>Cruziohyla calcarifer</i>						X	X									2
Phyllomedusidae	<i>Cruziohyla craspedopus</i>	X	X								X				X		4
Phyllomedusidae	<i>Phyllomedusa tarsius</i>	X	X						X		X	X		X	X		7
Phyllomedusidae	<i>Phyllomedusa vaillantii</i>	X	X						X		X	X		X	X		7
Phyllomedusidae	<i>Pithecopus palliatus</i>		X														1
*Plethodontidae	<i>Bolitoglossa chica</i>						X	X		X							3
*Plethodontidae	<i>Bolitoglossa equatoriana</i>		X								X	X			X		4
*Plethodontidae	<i>Bolitoglossa medemi</i>						X	X									2
*Plethodontidae	<i>Bolitoglossa palmata</i>											X					1
*Plethodontidae	<i>Bolitoglossa sima</i>				X		X	X									3
*Plethodontidae	<i>Oedipina ecuatoriana</i>						X										1
*Plethodontidae	<i>Oedipina villamizariorum</i>						X										1
**Caeciliidae	<i>Caecilia abitaguae</i>	X					X										2
**Caeciliidae	<i>Caecilia albiventris</i>		X														1
**Caeciliidae	<i>Caecilia attenuata</i>											X					1
**Caeciliidae	<i>Caecilia bokermanni</i>														X		1

TABLE 0.5 (Continued)

Distribution of 655 Species of Ecuadorian Amphibians in 15 Biogeographic Sectors (*sensu* Ministerio del Ambiente del Ecuador, 2013).

Family	Species	AC	APC	CA	CCC	CCEP	COA	EC	FP	JZ	NC	NCOA	P	SCOA	TP	V	# sectors
**Caeciliidae	<i>Caecilia buckleyi</i>						X										1
**Caeciliidae	<i>Caecilia crassisquama</i>	X															1
**Caeciliidae	<i>Caecilia disossea</i>		X								X	X			X		4
**Caeciliidae	<i>Caecilia dunni</i>											X					1
**Caeciliidae	<i>Caecilia guntheri</i>						X										1
**Caeciliidae	<i>Caecilia leucocephala</i>					X	X	X									3
**Caeciliidae	<i>Caecilia nigricans</i>				X	X	X	X		X							5
**Caeciliidae	<i>Caecilia orientalis</i>											X					1
**Caeciliidae	<i>Caecilia pachynema</i>			X			X									X	3
**Caeciliidae	<i>Caecilia subterminalis</i>																0
**Caeciliidae	<i>Caecilia tentaculata</i>		X								X	X			X		4
**Caeciliidae	<i>Caecilia tenuissima</i>									X							1
**Caeciliidae	<i>Osgoecia bassleri</i>		X								X	X					3
**Caeciliidae	<i>Osgoecia equatorialis</i>						X	X									2
**Rhinatrematidae	<i>Amazops amazops</i>											X					1
**Rhinatrematidae	<i>Epicrionops bicolor</i>			X			X										2
**Rhinatrematidae	<i>Epicrionops petersi</i>											X		X			2
**Siphonopidae	<i>Microcaecilia albiceps</i>		X												X		2
**Siphonopidae	<i>Siphonops annulatus</i>		X						X		X	X			X		5
**Typhlonectidae	<i>Chthonerpeton onorei</i>											X					1
**Typhlonectidae	<i>Potomotyphlus kaupii</i>														X		1

Note: * = Caudata, ** = Gymnophiona. Abbreviations are as follows: Amazonian Cordilleras = AC; Aguarico-Putumayo-Caquetá = APC; Catamayo-Alamor = CA; Cordillera Costera of Chocó = CCC; Cordillera Costera of Equatorial Pacific = CCEP; Cordillera Occidental of the Andes = COA; Equatorial Chocó = EC; Fan of Pastaza = FP; Jama-Zapotillo = JZ; Northern Cordillera Oriental of the Andes = NCOA; Napo-Curaray = NP; Páramo = P; Southern Cordillera Oriental of the Andes = SCOA; Tigre-Pastaza = TP; Valleys = V.



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1 Anura: Family Phyllomedusidae

LEAF FROGS

Phyllomedusidae Günther, 1858: 346. **Type genus.**—*Phyllomedusa* (Wagler, 1830).

Etymology.—The familial name is derived from the Greek words *phyll*, meaning leaf, and *Medousa*. The name alludes to the gelatinous egg masses deposited on leaves of trees.

Definition.—Phyllomedusid frogs are a monophyletic group diagnosed on the basis of molecular evidence and phenotypic features. Putative myological synapomorphies are: (1) submandibular intermandibularis muscle bearing a wide aponeurosis, and (2) posterolateral supplementary elements of the submandibular intermandibularis present, inserted in the ventral surface of the principal element of the intermandibularis.

The SVL varies from 45 mm in *Callimedusa atelopoides* to 119 mm in *Phyllomedusa bicolor*. The iris is vertically elliptical. The pectoral gridle is arciferous. They have eight procoelous presacral vertebrae. The calcaneum and astragalus are separated. There are intercalary cartilages between the terminal and penultimate phalanges. The terminal phalanges are claw-shaped. The chromosome complement is $2n = 26$.

Distribution.—Phyllomedusids occur in the Neotropics, from Mexico to northern Argentina.

Content.—The family contains eight genera with 67 species. Five genera (*Agalychnis*, *Callimedusa*, *Cruziohyala*, *Phyllomedusa*, *Pithecopus*) occur in Ecuador.

Remarks.—Figure 1.1. Phyllomedusids have been treated as a family by Günther (1858), Bossuyt and Roelants (2009), Duellman *et al.* (2016), Schmid *et al.* (2018). We adopt the family category for this monophyletic group instead of the subfamily rank (under Hylidae) that is chosen by other authors (see Frost, 2023). Faivovich *et al.* (2010) performed a parsimony analysis of 45 species and Duellman *et al.* (2016) a maximum likelihood analysis of 46 species, 78% of the known members of the family. The same lineages emerge. The latter authors recovered a major lineage of phyllomedusids with 100% support. Within this group, there are large frogs of the genus *Phyllomedusa* (100% support) with vomerine teeth and another lineage with 100% support of smaller frogs lacking vomerine teeth (100% support). Within the latter are two lineages with significant support. One lineage, *Pithecopus* (100% support), is characterized by having opposable thumbs and no bright flash colors. In the second lineage, *Callimedusa* (78% support), the thumb is not opposable, and with one exception, all have bright flash colors.

GENUS AGALYCHNIS (LEAF FROGS) COPE, 1864

Agalychnis Cope, 1864: 181. **Type species.**—*Hyla callidryas* (Cope, 1862) by original designation.

Etymology.—The generic name is from the Greek *aga*, an intensive prefix, and the Greek *lychnis*, a plant with scarlet flowers. Presumably, the name refers to the red-eyed treefrog, *Agalychnis callidryas*, the type species of the genus. The gender is feminine.

Definition.—Figure 1.2. *Agalychnis* is a group supported by molecular evidence. No morphological synapomorphies are known. The genus is composed of a range of similar-looking frogs, from the slender *A. lemur*, reaching a maximum SVL of 47 mm, to the larger-sized *A. spurrelli* at 110 mm; others such as those in the *A. callidryas* group are medium-sized, and others such as *A. dacnicolor* are more heavily built. This genus only includes phyllomedusids that have a single rather than bicolored iris (a characteristic seen in *Cruziohyala* and *Phrynomedusa*). The parotid glands in *Agalychnis* are absent or poorly developed. Extensive webbing is present on both the hands and feet of many *Agalychnis* species but is lacking or well reduced in those species previously named *Hylomantis* and *Pachymedusa*. Vomerine teeth are present, and most species that do have extensive webbing (except *A. dacnicolor*) also have a reticulated palpebral membrane to cover the eye. Egg-laying occurs on open leaves rather than folded, as seen in *Phasmahyla* and *Phyllomedusa*, or on tree trunks and lianas. The tadpoles of *Agalychnis* all have moderately small oral discs that are directed anteroventrally.

Distribution.—The genus occurs in the Pacific lowlands of Mexico from southern Sonora south, including the Balsas Depression and the State of Mexico, to the Isthmus of Tehuantepec; tropical southern Mexico and Central America; the Pacific lowlands of Colombia and northwestern Ecuador; and the upper Amazon Basin and lower Andean slopes in Colombia, Venezuela, and northeastern Peru, likely into eastern Ecuador.

Content.—Currently, 14 species are recognized in this genus. Four species are known in Ecuador.

Remarks.—Figure 1.3. Gomez-Mestre *et al.* (2008), Faivovich *et al.* (2010), and Pyron and Wiens (2011) provided a molecular phylogeny of species currently under *Agalychnis*. According to Duellman *et al.* (2016), the inclusion of *Agalychnis hulli* and *A. lemur* in this genus is problematic, even though their respective support values (88% and 75%) are relatively high. *Agalychnis hulli* is a geographic enigma inasmuch as it is a member of the

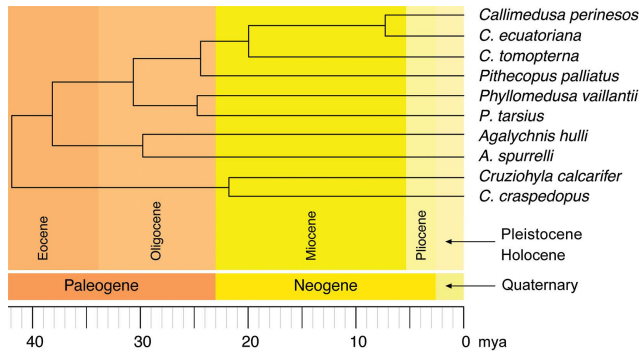


FIGURE 1.1 Time-calibrated maximum likelihood phylogenetic tree depicting evolutionary relationships of some of the Ecuadorian species of Phyllomedusidae, inferred from DNA sequences of mitochondrial and nuclear genes. Tree by Juan C. Santos (this publication).



FIGURE 1.2 High-resolution computed tomography reconstructions of the skeleton of *Agalychnis spurrelli*, CJ 2224, Reserva Otokiki, Alto Tambo, Provincia Esmeraldas. Left: dorsal view of the skeleton. Dorsal (left) and ventral (right) views. Daniel J. Paluh.

“*Phyllomedusa buckleyi* group” as defined by Cannatella (1980) and exists in the Amazon Basin (Duellman and Mendelson, 1995), whereas other members of the group live in cloud forests on the slopes of the Andes and Central American highlands. *Agalychnis lemur* is the only species in the so-called “*Phyllomedusa buckleyi* group” in their analysis. Molecular data are needed from *A. buckleyi*, *A. danieli*, *A. medinae*, and *A. psilopygion* before the phylogenetic relationships can be clarified for a suitable classification.

Gomez-Mestre *et al.* (2008) studied the evolution of hatching plasticity in *Agalychnis* in a phylogenetic context. According to them, premature hatchlings of *Agalychnis* are more vulnerable to fish predation than are full-term hatchlings, indicating a conserved risk trade-off across hatching that would make plasticity advantageous. In contrast, the hatching response to snake attack has undergone major changes at least

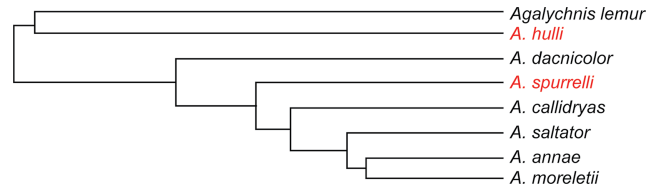


FIGURE 1.3 Topology of a tree analysis of *Agalychnis* based on molecular data, showing species occurring in Ecuador (in red). Taken and modified from Pyron and Wiens (2011).

twice in the *Agalychnis* lineage, with two species showing substantially lower escape success than the others. Responses to different threats have thus evolved independently.

In the 2010s, the United States of America alone imported 221,960 *Agalychnis* frogs, according to the Species Survival Network (SSN). In a resolution adopted on 2 March 2010 by the Convention on International Trade in Endangered Species (CITES) of Wild Fauna and Flora, all species belonging to the genus *Agalychnis* at that time were listed in Appendix II.

AGALYCHNIS BUCKLEYI (BUCKLEY'S LEAF FROG) (BOULENGER, 1882a)

Phyllomedusa buckleyi (Boulenger, 1882a): 425. **Holotype.**—BMNH 1947.2.22.35 from Sarayacu, Provincia Pastaza, Ecuador.

Agalychnis buckleyi (Faivovich *et al.*, 2010): 259.



Etymology.—The specific name is a patronym that honors Clarence Buckley (1868–1878), who collected the holotype and many other specimens for the British Museum (Natural History).

Identification.—Figure 1.4. In these frogs, males attain an SVL of 44.5 mm, and females of 54.7 mm. The head is slightly wider than the body. The snout is short, acutely rounded in dorsal view; in lateral view, it is sloping and rounded from lip to nostril in both sexes. The canthus rostralis is rounded, distinct. The loreal region is concave. The lips are thin and not flared. The nostrils are not protuberant, directed laterally. The internarial region is flat. The eyes are large and protuberant. The pupil is vertically elliptical. The eyelid is clear. The parotoid glands are not differentiated. The supratympanic fold is thin, indistinct, obscuring the dorsal edge of the tympanum and up to one-half of the tympanum in some; the fold extends posteroventrally to a point above the insertion of the arm. The tympanum is barely distinct, round, separated from eye by distance equal to the horizontal diameter of the tympanum. The upper arm is slender; the forearm is robust. The ulnar fold is low,



FIGURE 1.4 *Agalychnis buckleyi*. QCAZ 680, subadult, km 10, road Hollín-Loreto, Provincia Napo. LAC.

indistinct. The fingers are moderately long. The relative length of fingers from shortest to longest is 1-2-4-3. The digital discs are of moderate size, rounded. The subarticular tubercles are large and subconical. The distal tubercle on finger IV is bifid in most specimens. The palmar tubercle is low, diffuse, rounded. The prepollex is slightly enlarged and bears thin, horny nuptial excrescences in breeding males. There is slight rudimentary webbing between the last three fingers. The legs are moderately long and slender. There is a small, blunt calcar on the heel. There are a few small tubercles below the calcar. The inner tarsal fold is barely distinct; the outer tarsal fold is barely distinct, appearing merely as a row of low tubercles in some. The toes are of moderate length; the relative length from shortest to longest is 1-2-3-5-4; the discs are rounded, smaller than those on the fingers. The inner metatarsal tubercle is flattened, low, and elliptical. The outer metatarsal tubercle is small and rounded. Webbing is absent between toes I and II. There is rudimentary webbing between toes II and III and basal webbing between other toes. The anal opening is directed ventrally at the midlevel of the thighs. There is a short anal flap. The para-anal region is tubercular. The skin on the dorsum is minutely granular. There are white dorsal warts on some

specimens and small granules in the loreal and temporal regions. The skin on throat, belly, and posteroventral surface of the thighs is distinctly granular; the skin elsewhere is smooth. The tongue is lanceolate, notched posteriorly, free for about one-half of its length. Vomerine teeth are present in most individuals; the dentigerous processes of the prevomers are small, moderately separated medially, oriented posteromedially at the anterior level of the choanae. Vocal slits are present in males; they are short, parallel to the jaw, extending from the posterolateral corner of the tongue to the corner of the mouth. The vocal sac is single, median, and subgular. The quadratojugal is present. The sacro-coccygeal articulation is bicondylar.

The dorsum is lavender-brown by night; by day, the dorsum is pale green to yellow-green with purple flecks. The dorsal surfaces of the toe and finger discs are yellowish-white with green wash. The ventral surfaces of hands and feet are flesh-colored. The venter is cream with an orange wash; the throat is off-white with a pale orange wash. The flanks and concealed surfaces are bright orange, fading to cream on the edges. The ulnar and tarsal folds and the anal tubercles are off-white. The dorsal warts are pale yellow. Finger IV is green dorsally, fading to pale yellow. Finger III is dirty yellow. Fingers I and II are orange dorsally. The eyelid is clear; the upper border is slightly pigmented. The iris is dirty cream. In a newly metamorphosed individual, the dorsal surfaces of the body and limbs are pale green with a yellow wash. The dorsal surface of the toe pads and concealed surfaces of the toes are dull orange; the dorsal wart is light yellow. The venter is fleshy orange. The upper lip is dirty yellow. The iris is off-white.

Comparisons.—*Agalychnis hulli*, *A. psilopygion*. *Agalychnis buckleyi* differs from *A. hulli* by having a smaller tympanum (mean tympanum/eye = 0.352) that is barely evident, whereas the larger tympanum (mean tympanum/eye = 0.489) is distinct in *A. hulli*. Furthermore, *A. buckleyi* differs from *A. hulli* by having a small calcar and usually having a small outer metatarsal tubercle. The dorsal skin is finely granular in *A. buckleyi* and coarsely granular in *A. hulli*. *Agalychnis psilopygion*, from the Pacific lowlands, has a large calcar and no para-cloacal tubercles.

Natural history.—Most individuals have been found at night on low vegetation overhanging pools of water. From field observations, the call is known to be a short “cluck.” A female in amplexus deposited 98 eggs in a plastic bag. A similar sized clutch was found on vegetation above water. The eggs are quite large, having a total egg capsule diameter of approximately 4.5 mm at stage 8; that of the egg yolk alone is about 3.1 mm in size. The yolk is green, and the jelly is clear. Tadpoles have been found in streamside pools, temporary ponds, and puddles. *Agalychnis buckleyi* is sympatric with *Phyllomedusa vaillantii* and *P. tarsius* in the Río Pastaza Valley, Provincia Pastaza, and with *Callimedusa perinesos* in the Río Quijos Valley, Provincia Napo. At Río Salado, Provincia Napo, on 17–19 March 1975, 12 *C. perinesos* were taken from low vegetation around the pond and



FIGURE 1.5 Tadpole and metamorph of *Agalychnis buckleyi*. Top four: El Reventador, La Virgen, Provincia Napo. LAC. Bottom: CJ 13068, stage 46 = 28.6 mm SVL, trail Cascadas de Baeza, Provincia Napo. SGS.

cutover forest at the same locality. Seven *A. buckleyi* were collected in low vegetation adjacent to the pond; none were taken from the cutover forest. At this same site, about 60 *C. perinesos* and five *A. buckleyi* were collected on the evening of 17 July 1977 following a light rain. All of the *A. buckleyi* were taken from low vegetation overhanging a small pond; the specimens of *C. perinesos*, including amplexant pairs, were also found around the same pond, but the vast majority were in the surrounding forest clearing, several meters from water. These limited data suggest spatial segregation for the two species.

Tadpoles.—Figure 1.5. The tadpole was described based on 45 tadpoles from the Río Azuela and Río Salado, Provincia Napo, Ecuador, ranging in development from stage 25 to 41. They have body lengths of 8.4–24.1 mm and a total length of 22.1–58.0 mm. The following description is based on two of these specimens. The body is as wide as deep, deepest and widest at two-thirds the length of the body. The top of the head is slightly convex. The snout is acutely rounded in lateral profile; in dorsal view, it is almost truncate. The nostrils are dorsolateral, directed anterolaterally. The internarial distance is less than the width of the oral disc. The eyes are dorsolateral and directed laterally. The spiracle is a flap-like tube, ventral and sinistral to the midline. The spiracular opening is at about the midlength of the body. The

chondrocranial elements are not visible through the skin. The mouth is anteroventral and directed anteriorly. The cloacal tube is short and dextral to the caudal fin. The slender caudal musculature tapers gradually to the posterior end of the fin. The myomeres are moderately developed. At the midlength of the tail, the depth of the caudal musculature is slightly less than the depth of the ventral fin but greater than that of the dorsal fin. The musculature extends to the tip of the tail. The dorsal fin is shallow anteriorly, not extending onto the body; the fin is deepest at two-thirds its length from the anterior portion; the ventral fin is deepest at the midlength. The mouth is small, with a shallow lateral fold. The medial portion of the upper lip lacks papillae; elsewhere, papillae are present in two to three rows along the border; a few papillae are present medially to the border in the region of the lateral fold. The upper beak is moderately deep, with about 12 coarse serrations medially, otherwise finely serrate. The lower beak is shallow and finely serrate. There are two upper and three lower rows of denticles. The upper rows are of the same length; the first upper row is uninterrupted; the second row is narrowly broken medially. The three lower rows are of equal length, unbroken; the denticles of the first upper and third lower rows are smaller than those of other rows.

The body is olive brown above. The venter is silver-yellow to creamy green with greenish-gold iridescence laterally. The caudal musculature is cream to tan. The fins are transparent. The iris is silver to bronze. Metamorphs' emerging forelimbs have a green dorsum.

Distribution.—Figure 1.6. *Agalychnis buckleyi* occurs in the upper Amazon Basin and lower Amazonian slopes of the Andes in Ecuador and Colombia (Caquetá and Santander). In Ecuador, it occurs in Sucumbíos, Napo, Pastaza, and Tungurahua provinces. Its elevational range is 1176–1674 m with an extent of occurrence of about 2950 km².

This species inhabits subtropical forests and intervening areas in the evergreen low montane forest ecosystem of the northern Cordillera Oriental of the Andes biogeographic region, where the average annual rainfall is 1964–3600 mm and the average annual temperature is 18.1–24 °C.

Conservation.—*Agalychnis buckleyi* is categorized as Least Concern throughout its entire range (Castro *et al.*, 2004b; in IUCN Red List of 2022). In Ecuador, Ortega-Andrade *et al.* (2021) categorized it as Vulnerable. According to the latter authors, in Ecuador, this species exhibits an extent of occurrence of about 12,917 km². Our calculations of the area of occurrence in Ecuador are much lower (2950 km²); thus, we suggest including it in the Endangered category given that its extent of occurrence is less than 5000 km² and there is a continuing decline in the area, extent, and/or quality of habitat. This species is mostly threatened by agriculture, roads, oil pipelines, a hydroelectric plant, deforestation, and volcanism from the El Reventador volcano. It is an uncommon species. In Colombia, the Santander population overlaps with the Guanenta-Alto Río Fonce National Park. In Ecuador, it has been recorded in

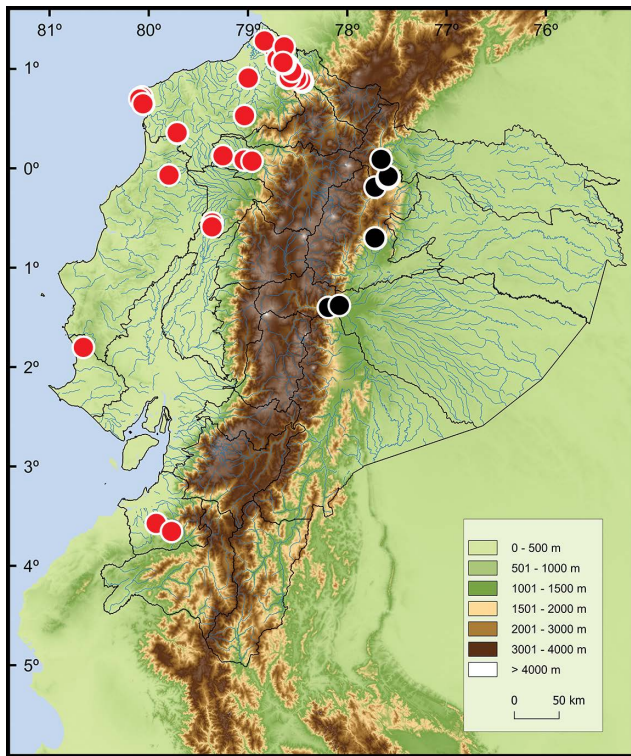


FIGURE 1.6 Localities of known occurrence of *Agalychnis buckleyi* (black dots) and *A. spurrelli* (red dots) in Ecuador.

the public reserves Parque Nacional Cayambe Coca and Parque Nacional Llanganates, the protected forests of Cerro Sumaco y Cuenca Alta del Río Suno, and the biosphere reserve Sumaco.

Remarks.—Its molecular phylogenetic relationships are unknown. It is in the *Agalychnis buckleyi* group *sensu* Faivovich *et al.* (2005). But Faivovich *et al.* (2010) excluded this species from any formal species group. The holotypes of *P. buckleyi* and its two junior synonyms (*Phyllomedusa loris* and *Hyla porifera*) are from the Río Pastaza drainage. Taxonomic research is needed to determine whether or not there are two different species in Colombia, considering the disjointed nature of the species distribution.

Key references.—(Boulenger, 1882a) (description, conservation); (Cannatella, 1980) (redescription, account, tadpole).

AGALYCHNIS HULLI (HULL'S LEAF FROG) (DUELLMAN AND MENDELSON, 1995)

Phyllomedusa hulli (Duellman and Mendelson, 1995): 348.

Holotype.—URP-WED 60198 from 1.5 km north of Teniente López, 310 m, Provincia Loreto, Departamento Loreto, Peru.

Agalychnis hulli (Faivovich *et al.*, 2010): 259.



Etymology.—The specific name is a patronym that honors Clark Hull, former Environmental Manager of the Occidental Petroleum Company. His broad outlook on environmental issues set an outstanding example in Peru.

Identification.—Figures 1.7, 1.8, 1.9. In these frogs, males attain a maximum SVL of 37.1 mm, and females are unknown. The maximum known mass is 1.5 g in a male. The head is barely wider than the body. The snout is short, narrowly rounded in dorsal view, sloping anteriorly from the level of the nostrils to the margin of the lip in profile. The nostrils are moderately protuberant, directed dorsolaterally, at a level posterior to the anterior margin of the lower jaw. The internarial region is slightly depressed. The canthus rostralis is straight, acutely rounded in section. The loreal region is slightly concave. The lips are thin, not flared. The top of the head is flat; the interorbital distance is greater than the width of the upper eyelid. The eyes are large, protuberant; the pupil is vertically elliptical. The eyelid is clear. The parotoid glands are not differentiated. The supratympanic fold is thin, extending to a point above the angle of the jaw, not obscuring the upper edge of the tympanum. The tympanum is round, distinct, with a slightly elevated annulus, separated from



FIGURE 1.7 *Agalychnis hulli*. Left: CJ 6467 (top and middle), female. CJ 6490 (bottom), female. Right: CJ 2045, male, 33.5 mm SVL. Reserva Otoyacu, Provincia Pastaza. LAC.



FIGURE 1.8 Morphological variation in *Agalychnis hulli*. Top left: QCAZ 40924, Centro Ecológico Zanja Arajuno, Provincia Pastaza. Top right: CJ 2047, male, 48.9 mm SVL. Bottom left: CJ 6467, female. Reserva Otoyacu. Provincia Pastaza. Bottom right: Centro Ecológico Zanja Arajuno. LAC.



FIGURE 1.9 Morphological details of *Agalychnis hulli*. Top: CJ 4741, note color change in the same individual. Bottom: CJ 6467, female, Reserva Otoyacu, Provincia Pastaza. LAC.

the eye by a distance equal to two-thirds of the diameter of the tympanum. The upper arm is slender; the forearm is moderately robust. The dermal fold from the elbow to the base of the disc on finger IV is narrow, slightly crenulated. The fingers are moderately short, flattened in section, lacking webbing but having narrow lateral fringes on each side of each digit. The discs are round. The diameter of the disc on finger III is equal to the diameter of the tympanum. The relative length of the fingers is $I < II < IV < III$. The distal subarticular tubercles are conical; the proximal subarticular tubercles are round, barely elevated. The supernumerary tubercles are diffuse, present only on the proximal segments of the digits; the palmar tubercle is diffuse. The thenar tubercle is elliptical, poorly differentiated. There is a thin, keratinous nuptial excrescence on the dorsal surface of the basal part of the thumb. The hind limb is slender. The calcar and tubercles on the heel are absent. The outer tarsal fold is distinct, crenulated, extending from the heel to the base of the disc on toe V. The

inner tarsal fold is absent. The outer metatarsal tubercle is absent. The inner metatarsal tubercle is low, elliptical, and visible from above. The toes are moderately long with distinct lateral fringes, about one-fourth webbed. The foot is about half webbed among toes III–V. The relative length of toes is $I < II < III < V < IV$. The digital discs are round, about equal in size to those on the fingers. The distal subarticular tubercles are conical; the proximal subarticular tubercles are round, elevated. The supernumerary tubercles are indistinct. The cloacal opening is directed ventrally at the lower level of the thighs; the cloacal sheath is long. The para-cloacal tubercles are present. The quadratojugal is present. The sacro-coccygeal articulation is bicondylar. The skin on the dorsal surfaces, except the upper arms and digits, is coarsely granular. The skin on the belly is weakly granular. The skin on other surfaces is smooth. Sometimes, there are one or two white, elevated warts on the body. The tongue is lanceolate, nearly three times as long as wide, distinctly notched posteriorly, free behind for about one-half of its length. The dentigerous processes of vomers each bear three teeth, angled postero-medially between large reniform choanae; they are moderately separated medially. The vocal sac is single, median, and subgular. The vocal slit extends from the midlateral base of the tongue nearly to the angle of the jaw.

At night, the dorsum is dark green with small, pale green flecks. By day, the dorsum is pale green; the flanks and hidden surfaces of the limbs are orange; the chin, belly, and labial, ulnar, tarsal, and infra-cloacal stripes are white. The iris is cream.

Comparisons.—*Agalychnis buckleyi*, *A. psilopygion*. *Agalychnis hulli* is unique in having coarsely granular skin on the dorsum; the dorsal skin is finely granular in *A. buckleyi*. Also, *A. buckleyi* has a smaller tympanum (mean tympanum/eye = 0.352) that is barely evident, whereas the larger tympanum (mean tympanum/eye = 0.489) is distinct in *A. hulli*. Furthermore, *A. buckleyi* differs from *A. hulli* by having a small calcar and usually having a small outer metatarsal tubercle. *Agalychnis psilopygion* has a calcar, no para-cloacal tubercles, and a truncate snout.

Natural history.—Figure 1.10. At Teniente López, Peru, an individual was perched on a leaf of a vine 4 m above the ground; the vine was attached to a tree at the edge of a forest pond. The frog was collected at 22:25 h. This pond was visited nightly for nine days (16–24 July 1993); no other individuals were observed. *Phyllomedusa tarsius* were found in trees near the pond, and four species of *Dendropsophus* (*D. koechlini*, *parviceps*, *rhodopeplus*, *sarayacuensis*) were calling from bushes and low herbs in and around the pond.

In Provincia Pastaza, amplexant pairs, egg clutches over leaves, and tadpoles were found in March 2008 and February 2014. Frogs were active at night on secondary vegetation up to 2.3 m, surrounding an artificial pond of about 4 m in length, and also around larger artificial and natural ponds. An egg clutch from Reserva Otoyacu contained 90 eggs. Amplexus is axillary, and multiple amplexus occurs.