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AMPHIBIAN & REPTILE CONSERVATION

THE INTERNATIONAL JOURNAL DEVOTED TO THE WORLDWIDE PRESERVATION AND MANAGEMENT OF AMPHIBIAN AND REPTILIAN DIVERSITY

Special Feature Issue

VENEZUELA

Distribution, species-richness, endemism, and conservation of Venezuelan amphibians and reptiles

This journal supports the programs of *Partners in Amphibian and Reptile Conservation* (PARC) to promote education about reptiles and amphibians and protection of their habitats.

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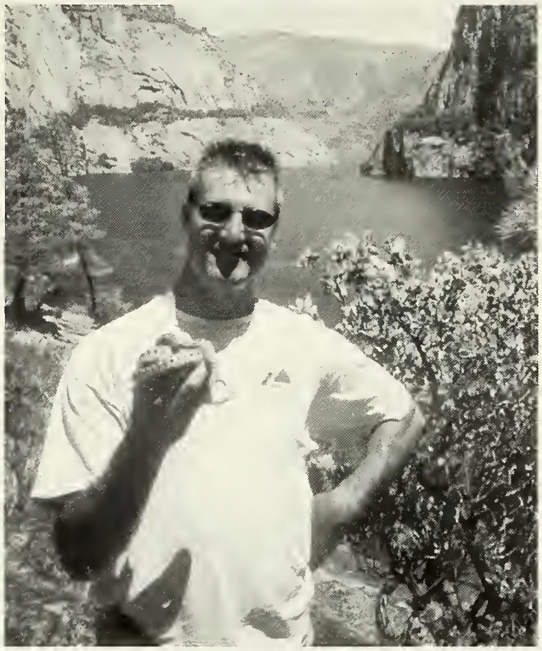
Editorial

WORDS FROM THE EDITOR—With the completion of this issue, we have successfully published our second volume. Our mission is further set, and I think it easy to visualize our intended mission, based on the observation of each new issue. *Amphibian and Reptile Conservation* (ARC) now numbers over 700+ subscribers and has printed and distributed 3,000 copies each of both issues 2 and 3, thus making ARC the largest distributed, English language, herpetological scientific journal in the world. I view my role with the journal as "carrying the torch" as editor and publisher, while many interested in assisting the journal have come "on board" as advisors or editors, special section editors, contributors, in-country liaisons, and in other ways. I am grateful for all of this assistance, and would like to invite others with a special interest or talent to contact me for more information and discussion. I am always open to feedback, new input, and ideas regarding the journal and/or the conservation of amphibians and reptiles worldwide, as well as all life. Again, I invite all to participate in what I feel is one of the most important concerns for all herpetologists, not just ones doing conservation related work. Now I would like to briefly outline our progress thus far.



CAROL LANCASTER MINGUS

Helping right a wrong. Our first day filming a documentary at Hetch Hetchy reservoir (background) and holding one of our extras, a bullsnake *Pituophis melanoleucus*, which wandered across our trail. Reference: *www.hetchhetchy.org*

The idea for a journal devoted strictly to the conservation of amphibians and reptiles evolved after I sadly left a brief stint at dental school in 1991, much too early to ever practice. Though it was a rather down time for me then (and not the last hurdle I would have to overcome), I found that it would be several more years before I would determine what my life's work could be. After spending about three years doing a lot of bookwork in the libraries of primarily Utah after leaving dental school, I met a publisher, zoologist, and a former classmate of mine [in my first graduate level class as a student at Brigham Young University (BYU)], Jay Vilhena. It was he that most directed my interest in herpetology into something more concrete and credit should be kindly given. On a long road trip to New Mexico, to deliver a computer system, I told Jay I needed help with focusing my ideas of writing, research, conservation, and herpetology. After a long and contemplated discussion, as well as his background as a long-time friend and associate, Jay announced, that I should publish a newsletter devoted to my interests. This was 1994. After much thought, more time, and finally, some strong persuasions of a spiritual nature, I agreed to undertake the task. Eventually, I progressed the idea from a newsletter, to a scientific journal, to lastly, what I now refer to as a magazine styled, scientific journal. In October of 1996 we published our first modest journal. Fifteen hundred copies of the first issue proved to be far too few as we quickly ran out of stock in about February of 1997, as we continued to have a strong interest in the journal. After a move to the University of Arizona in Tucson, Arizona from my alma mater of BYU in Provo, Utah, in the late fall of 1997 as the first snow began to fall in Provo, the journal and myself were exposed to a new and exciting landscape. Work on the journal was agonizingly slow, but I continued to presevere and make some progress. To help move the journal forward, I again packed up and moved to my hometown of Modesto, California in the late summer of 1999, to be closer to my family and their influence. At each step of the way, throughout the years, I continued in good faith to steadily work and make needed associations to further the work on the journal, though not all of these associations were fruitful. I have left out many of the gory details for lack of space here, and/or left to some future conference gathering (informally), I can attest to the fact that it hasn't been an easy path to follow with many uncertainties and setbacks. One certainty is my unwavering commitment to continue forward regardless of what must be overcome along the way. Further, as conservation biologist Michael Soulé so accurately stated by telling me in a telephone conversion, it "takes a lot of gumption" to start a journal as I have done, and I would add, even more to continue in the face of adversity and uncertainty. However, with all struggles and tribulations comes moments of great joy and satisfaction for those who continue on. With the continued publication of this journal I invite all to share in our success. It is my rock solid, determined, and solemn devotion to continue on with the idea that there should be a journal accessible by as many people as possible, devoted to the conservation and preservation of amphibians and reptiles, and their habitats worldwide. Words of my favorite musical artist, whom I had the pleasure to meet just before I left Tucson, comes to mind as he eloquently sang in the album, *Late for the Sky*, and what I truly feel about my mission with the journal: "*Keep a fire burn'n in your eye... Don't let the uncertainty turn you around... Go ahead and throw some seeds of your own and somewhere between the time you arrive and the time you go, may lie a reason you were alive.*" (Jackson Browne 1974, select lines from the song, *For a Dancer*). It is with the publication of this issue that we gain momentum in contributing to the conservation of amphibians and reptiles worldwide.

Craig Hassapakis
Founder, Editor, and Publisher

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Cover

The polkadot tree frog (*Hyla punctata*) is a common inhabitant of the largest South American ecosystem, the Amazon, and it is also found within the borders of Venezuela. It dwells in both primary and secondary humid forests and is common in marshy areas along river borders, lakes, and flooded grasslands of lowland South America from Venezuela and Trinidad south to the Paraguayan Chaco, east of the Andes mountains. This treefrog becomes almost entirely red at night. Their diet consists of small invertebrates. *Photo kindly provided by Gail Shumway.*

SPECIAL FEATURE ISSUE
VENEZUELA

Background screen photograph (see in color on page 69): A view of the inside of San Eusebio cloud forest, in the Venezuelan Andes. Tree ferns and bromelids are characteristics. Venezuela, Mérida. *Photo: Jaime E. Péfaur.*

DEDICATION

This issue is dedicated to Maria, Ellizabeth, and Derick.

Scope: *Amphibian and Reptile Conservation* (ISSN: 1083-446X) [ARC] and the accompanying online edition (ISSN: 1525-9153) is a popularly accessible, peer-reviewed scientific journal of international scope, which is devoted to the worldwide preservation and management of amphibian and reptilian diversity. **Online edition**: The full-text online edition is available to subscribers FREE-OF-CHARGE as PDF (Portable Document Format) files through *ingenta* at: *www.ingenta.com*. The online edition may vary slightly from the print edition due to our reducing file sizes for efficient downloading over the Internet. Some background screens (photographs) are removed which are deemed not essential to the content of the article(s). There is also some loss of clarity to photographs in reducing article file sizes to a minimum. If clarity of photos is a problem, the print edition of the journal should be consulted. **Audience**: ARC is intended for a wide readership from nonprofessional to professional herpetologists, the general public, and scientists. **Frequency**: ARC publishes two issues per year (semi-annually). **Focus**: ARC concentrates on publishing timely information in the form of feature articles, original papers and data, reviews, reports, short communications, columns, commentaries, book reviews, editorials, and news and notes. **Distribution**: ARC is distributed worldwide by subscription as well as quality newsstands, bookstores, and select vendors. Delivery is guaranteed. ARC is also available as pay-for-view full-text articles online with *ingenta*. Included and available online at *ingenta* are full abstracts and complete bibliographic entries. Much of this same material plus more, such as FREE sample article(s), are available at the ARC website (*www.herpetofauna.com*). **Publisher**: Craig Hassapakis, *Amphibian and Reptile Conservation*, 2525 Iowa Avenue, Modesto, California 95358-9467, USA. Fax: (509) 695-8747; email: *publisher@herpetofauna.com*; website: *www.herpetofauna.com*. **Postmaster**: Please send change of address to ARC eight weeks prior to move. **Communications**: It is recommended that all correspondence be conducted via email: *ARC@herpetofauna.com* whenever possible. All other types of correspondence should be directed to ARC using the contact information above under publisher. **Subscriptions**: All subscribers receive four consecutively distributed issues with a minimum of two copies per year. **Categories**: Subscription rate categories are individual United States (US)$20 and institutional $40 (includes postage). All subscriptions outside the US include $7 for shipping and handling to regular subscription rate (non-US rate: individual $27 and institutional $47). **Single Issue Purchase**: Subscriptions to the journal are encouraged to reduce shipping costs and paper work but some may wish to purchase single issues as they become available. The cost for single copies is US$5.95 plus two dollars shipping within the United States. Outside the US please inquire about shipping costs. Pay-for-view method of securing articles online is available through *ingenta* at *www.ingenta.com*. Article price charge is $8 except for larger titles, which increase in price. Further pricing information available at *ingenta*. **Back issues**: Individual copies are available from the publisher for $12 each (Note: Volume 1, Number 1 is out-of-print). Facsimiles (photocopies) are available for $10 each once issues are out-of-print. Copies of individual articles can be purchased for $8 each except for articles covering an entire issue and these sell for the regular single-issue price. **Donations**: Contributions for the journal are gladly accepted. These specific resources are used to further the conservation of amphibians and reptiles with the goals of the journal. **Categories include**: Friends of ARC $40, Supporting $60, Contributing $100, Patron $250, Sustaining $500, and Founder (includes lifetime subscription to ARC) $1,000. All other contributors, excluding Founders, receive four consecutively distributed issues. **Payment**: All journal orders must be paid in US currency drawn on a US bank (credit card, check, or international money order). **Credit card payment**: Cards accepted are *Visa*, *Mastercard*, *Discover*, and *American Express*. **Website**: *www.herpetofauna.com*. **Production**: Manufactured and printed in the United States of America using recycled paper (containing 10% post consumed fiber) and soy based inks.

∞ This paper meets the requirements of ANSI/NISO Z39.48-1992 (Recomfirmed 1997) [American National Standard for Permanence of Paper for Publications and Documents in Libraries and Archives].

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Pseudoboa neuweiddii. Location: Venezuela, Guatopo. *Photo courtesy of Laurie J. Vitt*

All photographs and illustrations provided by the author, Jaime E. Péfaur, unless stated otherwise.

Amphibian and Reptile Conservation 2(2):42-70.

Distribution, species-richness, endemism, and conservation of Venezuelan amphibians and reptiles

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Abstract.—**This report assesses the macrodistribution of amphibian and reptile taxa, and compares the species-richness of the various biogeographical zones in which Venezuela is herein divided. The macrodistribution of 252 amphibians and 299 reptiles species was established for the eight defined biogeographical regions. On the basis of the presence or absence of species, these regions have been categorized into three units: a) those with fewer than 100 herpetological species (Maracaibo Lake, Lara-Falcón, and the Islands), b) those with more than 100 but less than 200 species (Andes, Coastal Range, Llanos, and Amazonas), and c) with more than 300 species (Guayana). An index of species-richness shows that some regions of Venezuela are among the most distinguished herpetological places worldwide; the Andes region is the highest with an index of 0.34. Endemics are given particular attention in the light of the current knowledge of the geographical distribution of every taxon. There are 181 amphibian and 119 reptile species endemic to Venezuela. In terms of conservation, turtles and crocodiles are the most threatened species, but some frogs, particularly those of the highlands, are also endangered. The existence of protected areas, together with management and scientific projects designed to protect Venezuela's amphibians and reptiles, and the increasing international concern for them, strengthen the hope of preserving its valuable herpetofauna populations, and other animal resources, for future generations.**

Resumen.—**La macrodistribución de 252 especies de anfibios y 299 especies de reptiles fue establecida para las ocho regiones biogeográficas en las que Venezuela se divide corrientemente. Sobre la base de la presencia o ausencia de especies las regiones se han subdividido en tres unidades: a) las que tienen menos de 100 especies (Lago de Maracaibo, Lara-Falcón y las Islas), b) las que tienen más de 100 pero menos de 200 especies (Andes, Cordillera de la Costa, Llanos, y Amazonas), y c) con más de 300 especies (Guayana). El índice de riqueza de especies demuestra que algunas de las regiones de Venezuela están entre lás regiones herpetológicas más notorias en el ámbito mundial; particularmente Los Andes sobresalen con un índice de 0.34. Se presta una atención particular a las especies endémicas a la luz del actual conocimiento de la distribución geográfica de cada taxón. Hay 181 especies de anfibios y 119 especies de reptiles consideradas como endémicas en Venezuela. En términos de conservación, las tortugas y los cocodrilos son los grupos más amenazados, pero algunos anfibios, particularmente los de alturas, también están en peligro debido a la declinación numérica de sus poblaciones. La existencia de áreas protegidas, unido a proyectos científicos y de manejo diseñados para proteger las especies amenazadas, y el aumento de la preocupación internacional, fortalecen la esperanza de que estos recursos faunísticos puedan preservarse para futuras generaciones.**

Key words. *Checklist, distribution, species-richness, endemism, conservation, Venezuela, amphibians, reptiles, herpetofauna*

Introduction

The great variety of ecosystems in South America has induced the development of a greatly diversified herpetofauna which is about a fourth of the total number of amphibian and reptile species in the world.

Venezuela is one of the 13 countries comprising South America. It lies in its northernmost portion and receives the climatic influences of the Caribbean Sea and Atlantic Ocean. In the north and northwest it is encased by the Andean Cordillera which in the Mérida Andes may attain a height of 5000 m. The extensive savannas in the central portion and the Amazonian forest of the south, contribute to a complex climate with an abundance of rainfall throughout most of the country, although there are drier areas in the region of Falcón, the Goajira Peninsula, and along the coast, as well. The terrestrial boundaries of Venezuela are continuous with Colombia on the west and southwest, Guyana on the east, and Brazil on the south. The existence of many large rivers and mountain ranges help make the country an environmental mosaic with a diverse fauna of amphibians and reptiles (Fig. 1).

This report assesses the macrodistribution of amphibian and reptile taxa, and compares the species-richness and the faunistical similarity of the various biogeographical zones in which the country is divided. Endemics are given particular attention in the light of the current knowledge of the geographical distribution of every taxon. Remarks on the conservation of these faunas are discussed.

Efforts have been made by several researchers to unravel the macrodistributional patterns of the diverse Venezuelan vertebrate groups. The distributional pattern of fishes were described by Mago-Leccia (1970); of amphibians by Rivero (1961,

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VENEZUELA

Venezuela is one of the 13 countries of South America, with an area of of 912,047 km^2 (slightly more than twice the size of California). It lies in the northern part of that continent just north of the Equator (geographic coordinates: 8°00 N, 66°00 W), is divided into 24 states (political divisions), and characterized by a diverse assemblage of landscapes, where a myriad of rivers and water bodies exist. The climate is tropical, hot, and humid in the lowlands but more moderate in the highlands; some dry environments are common along the coast. Venezuela is one of the main producers of oil in the world, but also produces natural gas, coal, iron ore, gold, bauxite, diamonds, other minerals, hydropower, and agricultural goods, such as sugar cane, coffee, rice, corn, wood and rhum, among others. The fauna and flora are diverse and it ranks among the top ten countries in regards to biodiversity worldwide being classified as a "megadiversity" country. There exist about 15,000 species of plants, more than 1,200 species of freshwater fishes, about 250 species of amphibians, 300 species of reptiles, more than 1,500 species of birds, and close to 350 species of mammals. With about 20,000,000 inhabitants and ninety percent of the population living north of the Orinoco River, the country shows a series of critical environmental problems, such as soil erosion and deforestation in the Andean and west central regions where agricultural activity is intense. Other environmental issues of concern are mining operations in protected areas, sewage pollution of Lago de Valencia, oil and urban pollution of Lago de Maracaibo, deforestation, urban and industrial pollution, especially along the Caribbean coast. Land tenure, hunting, and fires are also problems. Rights of ownership are not clarified in law, and continued occupation, new colonization and conflict within protected areas is common. The petroleum sector dominates the economy thus, is of great environmental concern as well as a potential threat to the environment. Many of these problems stem from the low priority given to conservation by the government as well as lack of equipment and trained staff for effective protection of natural resources. There are however, large areas of wilderness intact and more than a third of the country's surface are protected lands consisting of National Parks and Sanctuaries.

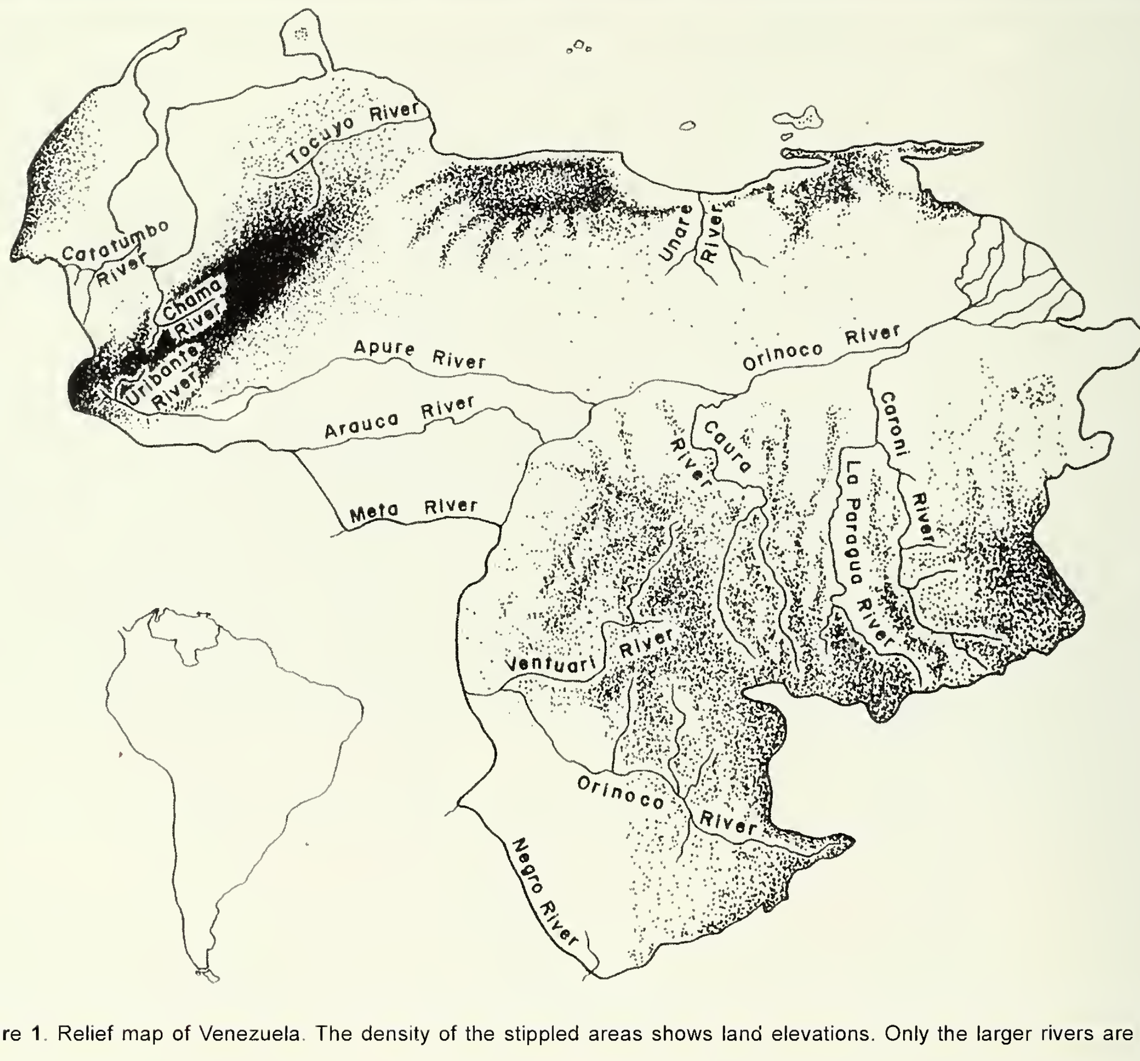

Figure 1. Relief map of Venezuela. The density of the stippled areas shows land elevations. Only the larger rivers are shown.

1963a, b, c, 1964a, b, c), Duellman (1988), Frost (1985), and La Marca (1992); of reptiles by Roze (1966), Medem (1981, 1983), Pritchard and Trebbau (1984), and Lancini (1986); and of mammals by Eisenberg and Redford (1979) and Bodini and Pérez-Hernández (1985). Some comprehensive studies on the herpetofauna from several areas of Venezuela have been provided by Staton and Dixon (1977), Duellman (1979), Hoogmoed (1979), Hoogmoed and Gorzula (1979), Rivero-Blanco and Dixon (1979), Péfaur and Díaz de Pascual (1982), Durant and Díaz (1996), and Yústiz (1996). Many other contributions about the distribution of orders (i.e., Brame and Wake 1963), families (i.e., Dixon and Hendricks 1979), genera (i.e., Dixon 1980; Di Bernardo 1992; Péfaur 1993; Señaris et al. 1994), and/or species (i.e., Gallardo 1965, 1969; Dixon and Michaud 1992) have been consulted. Additional references can be checked in Vanzolini (1978), Duellman and Trueb (1986), La Marca (1992), Péfaur (1992), and Duellman (1995), among others.

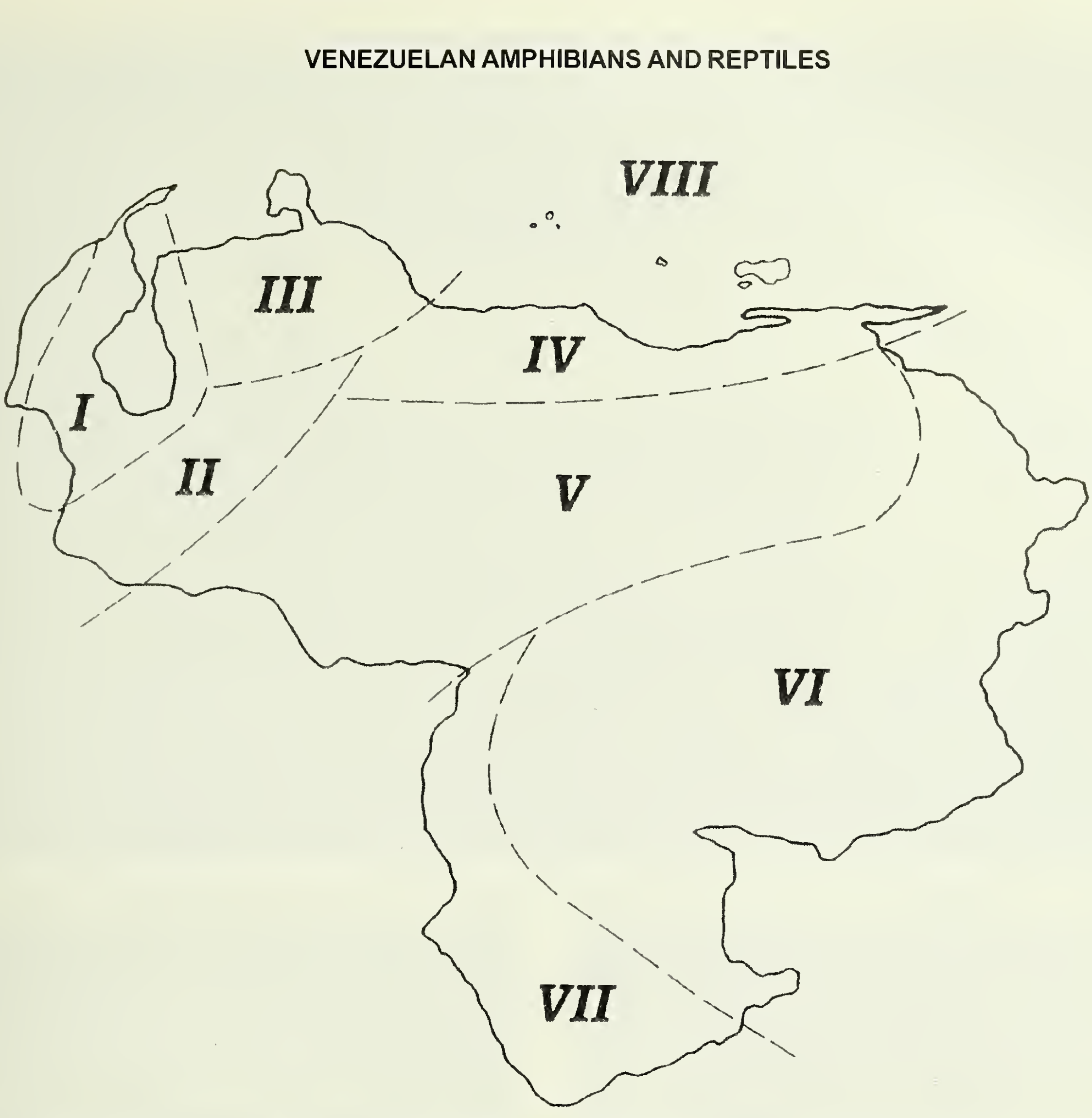

Figure 2. Sketch map of Venezuela, showing the main biogeographical regions: I. Maracaibo Lake, II. Andes, III. Falcón-Lara, IV. Coastal Range, V. Llanos, VI. Guayana, VII. Amazonas, and VIII. Islands.

Materials and methods

In order to assess the distributional records of each species, a map of Venezuela with its herein defined biogeographical regions was used. A biogeographic sketch of Venezuela is presented in Fig. 2. It contains the eight biogeographical zones commonly accepted for the country. This physiographic ensemble takes into account mainly the relief, climate, and vegetation (Marrero 1964; Ewel and Madriz 1968; Huber and Alarcón 1988). Although the boundaries of each region are not well defined, especially in some ecological nodules, they serve our purposes well. Different researchers have used this framework for their studies (Rivero 1963, 1964; Eisenberg and Redford 1979; Bisbal 1988; Péfaur and Rivero 1989).

The extent of each region is shown in Table 1. The land bordering Maracaibo Lake corresponds to Region I, which is covered by seasonally dry tropical forest in the north and by tropical lowland rain forest in the south. Wetlands also cover an extensive section of this region representing more than 3,500,000 ha. The southern extent of the Maracaibo Lake region is bordered by Region II, corresponding to the elevated mountains of the Cordillera de Mérida, and by the Cordillera de Perijá, on the northwest. Both ranges comprise the Andes region. For this study, all lands above 500 m are considered within the Andean unit and its biota as Andean; lands below 500 m are considered as piedmont. The Andes are environmentally complex (Ewel and Madriz 1968; Díaz et al. 1997), and may include premontane, dry and humid forests, montane wet and cloud forests, xerophytic valleys, hot and dry landscapes, and the impressive Páramos, highland tundras, occurring above 3000 m. This region covers about 4,200,000 ha of the country's surface.

The Falcón-Lara region or Region III also borders the northeastern part of the Maracaibo Lake region. This land is affected by the easterly drying winds of the Caribbean Sea and exhibit mostly a xerophytic landscape, catalogued as premontane dry shrub or dry forest. A large portion of the north sealine of Venezuela is bordered by the Coastal Range (Region IV), made up of forested mountains, with elevations up to 2765 m, and covered by premontane tropical rain and montane cloud forests. The Andes and the Coastal Range, slope down into the lowlands of the Llanos, Region V, which extends to the Orinoco River in the south, to the border with Colombia on the west, and extending to the Orinoco River delta in the east. The approximately 27,000,000 ha of the Llanos are covered by savannas or extensive prairies intermingled with dry

Plate 2

Plate 3

Plate 4

Plate 5

Plate 6

Plate captions: **2**. *Atelopus carbonerensis*. Once very abundant, this bufonid frog is now extinct from the Andean cloud forests. Venezuela, Mérida. **3**. *Bufo granulosus*. An inhabitant of all Venezuelan biogeographical zones. Venezuela, Aragua. **4**. *Bufo marinus*. One of the largest toads from Venezuela and the one with the largest distribution; it remains abundant country wide. Venezuela, Táchira. **5**. *Bufo typhonius*. Venezuela, Guatopo. *Photo courtesy of Laurie J. Vitt*. **6**. *Dendrobates leucomelas*. This attractive frog is found in the southern part of the country, south of the Orinoco River. Venezuela, Bolívar.

Table 1. Extent of land surface and number of life zones present in the biogeographical regions of Venezuela. (Source: Bisbal 1988; Ewel and Madriz 1968.)

Biogeographical region		Estimated land surface km²	%	Number of Life Zones
I	Maracaibo Lake	35,000	3.88	5
II	Andes	42,000	4.66	16
III	Falcón-Lara	30,000	3.33	6
IV	Coastal Range	68,000	7.54	10
V	Llanos	270,000	29.95	3
VI	Guayana	350,000	38.82	10
VII	Amazonas	105,000	11.65	2
VIII	Islands	1,500	0.17	6
	Total	**901,500**	**100.00**	**22**

Table 2. Surface of altitudinal belts in Venezuela. (Source: Ewel and Madriz 1968.)

Altitudinal belt	Area km²	%
Tropical lowlands	640,283	71.30
Premontane	227,390	25.00
Low montane	27,987	3.05
Montane	4,570	0.52
Subalpine and alpine	1,270	0.13
Total	**901,500**	**100.00**

forests and riverine gallery forests.

The largest biogeographical region of Venezuela is the Guayana, Region VI, which includes about 35,000,000 ha, most of which are part of the Venezuelan Guayana shield. The landscape is complex, including lowland, premontane and montane wet and rain forests; savannas; and wet oases, called *morichales*, rich in palms and herpetofauna. The landscape is defined by profound valleys bordered by *tepuys*, table mountain remains of geological lands of the Precambrian-Paleozoic era. The area belonging to the Orinoco River's delta is also included in this region. Some 10,500,000 ha of tropical forests covering the lowlands of the upper Orinoco River basin comprise Region VII, Amazonas, which is continuous with South America's large green core, the Amazonia. An important part of this area is covered by wet tropical forest.

A small portion of the country is made up of islands. All of them are included in Region VIII, which for the purpose of the distribution of turtles also includes the Venezuelan Caribbean Sea. This region is included to call attention to the particular distribution of the island herpetofauna, especially that of Isla Margarita, as well as maritime herpetofauna.

Each of these biogeographical regions is ecologically diverse and complex. In their ecological map, Ewel and Madriz (1968) described 22 life zones for Venezuela (Table 1). The most homogeneous biogeographical region, Amazonas, has only two life zones, and the most complex of all, the Andes, includes 16 life zones in its relatively small territory. Diversity of ecosystems is proportional to the steepness of versants, the sides of the mountains, in the tropics, but most of Venezuela is lowland. About three-fourths of the country is comprised of lands below 500 m; lands above 1000 m do not exceed 10% of the territory, yet these are the most ecologically diverse of all (Table 2), a situation with strong consequences on the biological features of the country.

Several methods have been used to obtain the data presented in this paper: museum records, bibliographic information, and personal observations. Reports made on the holdings of relevant museums in Venezuela, Puerto Rico, Colombia, Brazil, France, and the United States have been taken into account, but in most instances they have been improved with notes taken by the authors during their trips and museum visits. In order to update previous reports on the Venezuelan amphibians and reptiles (Péfaur 1992; Péfaur and Rivero 1989), new lists had to be produced. To the best of our knowledge the checklist database (Appendix 1) contains all known species up to December 31, 1996.

The distributional aspects of the list are given by the presence or absence of data for every species in a biogeographical region. The eight regions were thus delimited by the known information regarding the species' geographical distribution. The number of species present in a region is an indication of its species diversity and of the geological, climatological, and biological evolution of the faunal elements concerned. However, the index of species-richness, rather than the simple number of species, is a better expression of evolutionary trends. A Species-Richness Index (SRI) was calculated by considering the number of extant species divided by the area multiplied by (x) 100. To obtain the faunistical similarity between regions, a four-fold contingency table was created for every pair of compared regions and the Dice coefficient, as shown by Hayek (1994), was calculated.

Endemism, an ecological term, was determined by finding whether there was a unique relationship between a spe-

Table 3. Taxonomic composition of the Venezuelan herpetofauna.

Class/Order	Common name	Families	Genera	Species
Amphibia				
Anura	Frogs and toads	10	42	238
Caudata	Salamanders	1	1	2
Gymnophiona	Caecilians	3	7	12
Subtotal		14	50	252
Reptilia				
Testudines	Turtles and tortoises	7	14	23
Crocodylia	Crocodiles and alligators	2	3	6
Amphisbaenia	Amphisbaenians	1	2	6
Lacertilia	Lizards	8	37	113
Serpentes	Snakes	8	56	151
Subtotal		26	112	299
Total		**40**	**162**	**551**

Table 4. Allocation of amphibian and reptile species in the biogeographical regions of Venezuela.

	Biogeographical region								
Taxa	I	II	III	IV	V	VI	VII	VIII	Total
Frogs	18	72	17	63	36	127	53	5	238
Salamanders	0	1	0	1	0	0	0	0	2
Caecilians	2	2	1	2	0	7	2	0	12
Turtles	6	1	3	6	9	13	11	6	23
Crocodiles	1	0	1	2	2	3	5	1	6
Amphisbaenians	1	2	2	2	2	5	4	0	6
Lizards	20	26	25	39	19	59	36	16	113
Snakes	44	38	47	75	43	96	74	22	151
Total	**92**	**142**	**96**	**190**	**111**	**310**	**185**	**50**	**551**

Table 5. Species-Richness Index (SRI) value calculations for herpetofaunal species in the biogeographical regions of Venezuela. SRI = (Species number/area) x 100. The area to calculate the Index is provided in Table 1.

Biogeographic	Amphibian species		Reptile species		Total	Total
region	n	SRI	n	SRI	n	SRI
I	20	0.05	72	0.20	92	0.26
II	75	0.18	67	0.16	142	0.34
III	18	0.06	78	0.26	96	0.32
IV	66	0.10	124	0.18	190	0.28
V	36	0.01	75	0.03	111	0.04
VI	134	0.04	176	0.05	310	0.09
VII	55	0.05	130	0.12	185	0.18
Total	**252**	**0.03**	**299**	**0.03**	**551**	**0.06**

cies and a geographical region. As used in this study, whenever a species dwelled and apparently originated in a single region, it was considered a *biological endemic*. However, if a species was considered endemic because it occupied a single region in Venezuela but also extended into another country, it was considered as a *political endemic* with respect to the first country. In the case of Venezuela, there are mainly *biological endemics*, but there are also several *political endemics*, that is, species extending beyond the boundaries to some neighboring countries, such as Colombia, Brazil, and/or Guyana in the mainland, or Trinidad-Tobago, and the Dutch Islands (Bonaire, Aruba, Curaçao), in the Caribbean Sea.

To determine the conservation status of the herpetofauna, only a few quantitative assessments are available. Thus, a general impression rather than an accurate census supports the cataloging for the species considered.

Plate 7

Plate 8

Plate 9

Plate 10

Plate 11

Plate 12

Plate 13

Plate 14

Plate captions: **7**. *Mannophryne collaris*. The ventral side of the females of this species present a black collar and a yellow gular region. Venezuela, Mérida. **8**. *Nephelobates alboguttatus*. A very abundant species in the past, today it has disappeared from their geographical range. Venezuela, Mérida. **9**. *Nephelobates haydeeae*. This frog is found only in the western state of Táchira, where its populations are declining. Venezuela, Táchira. **10**. *Nephelobates meridensis*. This was the largest dendrobatid frog of western Venezuela. This species is probably extinct. Venezuela, Mérida. **11**. *Nephelobates serranus*. A very restricted frog, inhabiting only a part of the Sierra Nevada mountains. Venezuela, Mérida. **12**. *Flectonotus pygmaeus*. A marsupial frog that inhabits the northern mountains. Venezuela, Mérida. **13**. *Hyla crepitans*. This species dwells in most environments in the country. It remains very common. Probably conforms a taxonomical group of related species. Venezuela, Táchira. **14**. *Hyla lanciformis*. This large and slender brown frog has a wide distribution in the country. Venezuela, Táchira.

Table 6. Matrix of amphibian similarity among Venezuelan biogeographical regions. Note: This matrix shows in bold the amount of species of every region. Above the diagonal line are the similarity values between a pair of regions, while under it are the numbers of shared species. (Source of data: Appendix 1.)

	REGION						
REGION	I	II	III	IV	V	VI	VII
I	**20**	0.15	0.32	0.26	0.43	0.17	0.27
II	7	**75**	0.15	0.18	0.18	0.11	0.15
III	6	7	**18**	0.33	0.33	0.14	0.22
IV	11	13	14	**66**	0.45	0.25	0.28
V	12	11	9	24	**36**	0.36	0.46
VI	13	12	11	25	31	**134**	0.40
VII	10	10	9	17	21	38	**55**

Table 7. Matrix of reptile similarity among Venezuelan biogeographical regions. Note: See comments under Table 6. (Source of data: Appendix 1.)

	REGION						
REGION	I	II	III	IV	V	VI	VII
I	**72**	0.47	0.64	0.56	0.52	0.30	0.32
II	33	**67**	0.51	0.44	0.37	0.42	0.24
III	48	37	**78**	0.66	0.58	0.37	0.39
IV	55	42	66	**124**	0.56	0.47	0.46
V	38	26	44	56	**75**	0.56	0.62
VI	37	28	47	71	65	**176**	0.72
VII	32	24	41	59	59	110	**130**

Table 8. Number of endemic species and percentage of endemism in the herpetofauna of the biogeographic regions of Venezuela. (Source Data: Appendix 1.)

	Amphibians			Reptiles		
Regions	Species by region	Endemics	%	Species by region	Endemics	%
I	20	4	2.2	72	12	10.1
II	75	57	31.5	67	20	16.8
III	18	0	0.0	78	5	4.2
IV	66	32	17.7	124	19	16.0
V	36	1	0.6	75	2	1.7
VI	134	75	41.4	176	48	40.3
VII	55	12	6.6	130	13	10.9
Country's total	**252**	**181**	**60.3**	**299**	**119**	**39.7**

Results

Taxonomic composition

The herpetological component of the Venezuelan fauna consists of 551 species of which 252 are amphibians and 299 are reptiles. A taxonomic list of species is provided by a country checklist (Appendix 1) and summarized in Table 3. The amphibians of Venezuela are included in three orders, of which the largest is Anura. The most specious family is Hylidae, containing 77 species, followed by Leptodactylidae with 72 species. Other rather large families are Bufonidae, Centrolenidae, and Dendrobatidae. The rest of the frog families have a very low number of species. The families of salamanders and caecilians are also of minor number.

The reptiles are comprised within five orders of which the largest are Serpentes and Lacertilia. Turtles and tortoises have 23 species contained within seven families. Crocodiles and alligators have six species belonging to two families. The amphisbaenians are represented by only two genera and six species. The lizards have 113 species comprising eight families, with *Gonatodes* as its most specious genus, with 13 species. Snakes make up the most diversified group with 151 species belonging to eight families. Its largest family, the Colubridae, contains 104 species. All other families of this class have less than 40 species each. Its most specious genus is *Atractus* with 16 species; other quite large genera are *Liophis* and *Micrurus* with 10 and 12 species, respectively.

Distribution

The distribution of every species in the eight biogeographical regions, as considered in Appendix 1, is summarized in Table 4.

By far, the largest assemblage of amphibians and reptile species is found in Region VI, Guayana, followed by the Coastal Range, Amazonas, and the Andes. The lowest number of species in the country is found in the northern regions of Maracaibo Lake and Falcón-Lara. In the maritime islands region there are 50 species of amphibians and reptiles.

Species-richness

As surface area differences among the biogeographical divisions do not allow a direct comparison of the biodiversity by the number of herpetofaunal species alone, an index (SRI) is required to more accurately express the results. The SRI index values are shown in Table 5.

The country itself has a low value for the index, 0.06. However, the four smallest regions achieve the highest SRI and the opposite three largest regions have the lowest indexes.

Faunistic similarity

The herpetological similarity between the different biogeographical regions of Venezuela is presented in Table 6 and 7. Similarity based on amphibian species is rather low (Table 6); the least pair bound of regions is the Andes-Guayana, which share 12 species and have a similarity value of 0.11; the strongest bound is the Llanos-Amazonas pair, which have 21 species, with a similarity value of 0.46, followed by the Llanos-Coastal Range and Llanos-Maracaibo Lake pairs.

Regional similarity based on the reptile component of the fauna produces different results (Table 7). In general, the similarity region based on reptile species has higher values than when amphibians are considered. Here, the least similar pair region is the Andes-Amazonas, with a similarity value of 0.24, while the strongest bounded pair is Guayana-Amazonas, with 110 shared species and a similarity value of 0.72.

Endemism

There are 181 species of amphibians and 119 of reptiles considered to be *biological* and/or *political endemics* (Table 8). Overall there are more endemic species among the amphibians than among reptiles. However, four regions have less endemic amphibians than endemic reptiles. The Andes, the Coastal Range, and the Guayana are the places with more endemics in both taxa.

Conservation

Actual data on the conservation status of the herpetofauna is relatively scarce in Venezuela. The most relevant information on population status is provided by Ramo (1982), Praderio (1985), Silva et al. (1985), Péfaur and Díaz de Pascual (1987), Péfaur et al. (1987), Silva and Valdéz (1989), La Marca and Reinthaler (1991), Thorbjarnarson (1991), Péfaur and Pérez (1995), and Durant and Díaz (1996), among others. The Red Data Book of Venezuela (Rodríguez and Rojas-Suárez 1995) was helpful in establishing herpetofauna endangerment status.

The report elaborated by the senior author to the Declining Amphibian Populations Task Force (DAPTF) of The World Conservation Union [IUCN] (*in* Vial and Saylor 1993), on the declining status of amphibians was also used to generate a list of endangered species (Appendix 2). Several species of amphibians, among which there are seven species of Bufonidae (5 *Atelopus*, 2 *Oreophrynella*), four Centrolenidae (2 *Centrolene*, 2 *Hyalinobatrachium*), 15 Dendrobatidae (5 *Colostethus*, 2 *Mannophryne*, and 8 *Nephelobates*), five Hylidae (1 *Gastrotheca*, 4 *Hyla*), one Allophrynidae (1 *Allophryne*), seven Leptodactylidae (2 *Ceratophrys*, 3 *Eleutherodactylus*, 1 *Leptodactylus*, 1 *Pseudopaludicola*), and two Plethodontidae (2 *Bolitoglossa*) are reported as having a decline in their population numbers and thus species of special concern. Among reptiles there are several species on the verge of extinction, such as *Crocodylus intermedius*, *C. acutus*, *Caiman niger*, and *Podocnemis expansa*, as well as all the sea turtles.

Discussion

Taxonomic composition

The taxonomy of the Venezuelan herpetofauna changes continuously due to new research findings and systematic rearrangements. Substantial changes in the number of known species for every region have taken place in Venezuela during recent years. Descriptions of numerous new taxa have occurred in the last decades mainly among amphibians (Péfaur 1985; Rivero 1982a, b, 1985; Ayarzagüena 1992, among others). Important changes have recently been introduced to the taxonomy of the country's herpetofauna thus, changing the systematic scenery. Among frogs, the Centrolenid family has been divided into several genera (*Centrolene*, *Cochranella*, and *Hyalinobatrachium*) by Ruíz-Carranza and Lynch (1991). The Dendrobatidae was also generically rearranged with the introduction of *Epipedobates* and *Minyobates* by Myers (1987), *Aromobates* by Myers et al. (1991), and *Mannophryne* and *Nephelobates* by La Marca (1995). The Hylidae has also suffered some modification with the rearrangement of some *Ololygon* into the resurrected genus *Scinax* (Duellman and Wiens 1992), and the elaboration of a new genus *Tepuihyla* by Ayarzagüena et al. (1992b). Among the caecilians, a general taxonomic rearrangement of families and genera was proposed by Nussbaum and Wilkinson (1989) and Wilkinson (1996).

Among the reptiles, there have also been some taxonomic changes. Within the lizards, Iguanidae was divided into several families (Corytophanidae, Iguanidae, Polychrotidae, and Tropiduridae) by Frost and Etheridge (1989), while the genus *Anolis* was divided into five genera, of which two are present in Venezuela, *Dactyloa* and *Norops* (Savage and Guyer 1989). The Teiidae was also divided into two units, Gymnophthalmidae (small teiids) and Teiidae [macroteiids] (Presch 1980). Within the snake group, some colubrid genera have been revised modifying the taxonomy for the Venezuelan members; for instance, Dixon (1989) reviewed *Liophis* and other associated genera. Among the Crotalidae there was also a strong change with the partitioning of *Bothrops* into several genera: *Bothriechis*, *Bothriopsis*, *Bothrops*, and *Porthidium*, with considerable effect to the Venezuelan fauna (Campbell and Lamar 1989). Of course, classification will continue to change as it is a dynamic science, and new systems and names will be introduced changing subsequent lists of Venezuelan amphibian and reptile species. All systematic allocations and changes should be taken as temporary arrangements that will be modified by the collection of new data and insights by researchers.

Distribution

There is no single area in Venezuela where an amphibian and/or a reptile species is not present. From the most luxurious tropical wet forest of Amazonas to the vegetationally depauperate Páramos at the top of the Andean mountains, where numerous

Plate 15

Plate 16

Plate 17

Plate 18

Plate 19

Plate 20

Plate 21

Plate 22

Plate captions: **15**. *Hyla luteocellata*. Venezuela, Guatopo. *Photo courtesy of Janalee P. Caldwell*. **16**. *Hyla microcephala*. This small frog has one of the largest biogeographical distribution in northern South America. Venezuela, Trujillo. **17**. *Hyla vigilans*. One of the smallest frogs of the country; inhabits the Lago de Maracaibo Zone. Venezuela, Zulia. **18**. *Phyllomedusa trinitatis*. Venezuela Guatopo. *Photo courtesy of Laurie J. Vitt*. **19**. *Scinax rostratus*. A medium sized frog with a distribution along the northern lowlands. Venezuela, Mérida. **20**. *Eleutherodactylus lancinii*. An inhabitant of the páramos cold streams. Venezuela, Mérida. **21**. *Eleutherodatylus lentiginosus*. A small frog from the Andes versants. Venezuela, Mérida. **22**. *Eleutherodactylus vanadise*. A small frog occurring in the cloud forests of the Venezuelan Andes. Venezuela, Mérida.


Plate 23


Plate 24


Plate 25


Plate 26


Plate 27


Plate 28


Plate 29


Plate 30

Plate captions: **23**. *Leptodactylus wagneri*. A very elusive frog from most Andean environments, that can be detected by its peculiar call. Venezuela, Mérida. **24**. *Pleurodema brachyops*. One of the most popular frogs in the country by its color and dots in the rear part of the body. Venezuela, Portuguesa. **25**. *Pipa pipa*. This aquatic frog lives in the Llanos of Venezuela and Colombia. The picture shows a museum specimen with eggs imbedded in its back. Venezuela, Barinas. **26**. *Rana palmipes*. A typical frog from the lowlands of western Venezuela but that can occasionally seen in the forested valleys of the Andes. Venezuela, Táchira. **27**. *Pseudis paradoxus*. This medium sized frog is to be found in the marshes of the country's lowlands. Venezuela, Apure. **28**. *Bolitoglossa orestes*. One of salamanders that dwells in the cloud forests of the Andes. Venezuela, Mérida. **29**. *Caecilia subnigricans*. A worm-like amphibian of northern Venezuela, that extends its range into Colombia. Venezuela, Táchira. **30**. *Rhinoclemmys punctularia*. This small turtle inhabits the Lake of Maracaibo region. Venezuela, Zulia.

frogs and lizards species dwell (Hoogmoed 1979; Rivero-Blanco and Dixon 1979; Durant and Díaz 1996; Díaz et al. 1997), species abound; however, snakes have not invaded the páramos (Péfaur and Díaz de Pascual 1982; Díaz et al. 1997). Different physiological and behavioral adjustments are found in the fauna of each ecosystem, to cope with the contrasting climatological factors impinging on every zone. Several of the more noteworthy adaptive strategies are the development of several unique reproductive modes: developing eggs and tadpoles in tree cavities or bromeliads, or eggs on dorsum of females, or tadpoles carried on dorsum of males, such as occur in anurans (Duellman 1985), or the use of collective nest deposits under rocks, as occurs in the lizards of the Páramos.

Newly discovered and new locality records of species have changed the known distributional patterns for many amphibians and reptiles. For instance, in the Andean region, species totals have changed from 16 frog, 4 lizard, and 10 snake species (as reported by Duellman 1979), to 56 frog and 15 lizard species (as reported by Péfaur and Díaz de Pascual 1982), to 72 frog, 26 lizard, and 38 snake species reported in this study. The well-documented work by Lancini (1986) reports 133 snake species for the country to 151 species reported here. Our knowledge of the distribution of the Venezuelan amphibians and reptiles is quite acceptable at the present time, but an increase could be expected as new data is being collected all the time by researchers in the field. Both the Andes and the Guayana regions have been actively explored by groups of researchers from the University of Los Andes in Mérida and from Museo de Ciencias La Salle in Caracas, respectively (Ayarzagüena et al. 1992a, b; Péfaur 1993; Señaris et al. 1994; Durant and Díaz 1996), while active research on the herpetofauna of the Coastal Range is underway by researchers from Central University, Museum of the Agrarian Zoology Institution in Maracay (Manzanilla et al. 1995, 1996).

The distributional range of certain species is of concern. There is a dramatic difference between the distribution of some taxa extending over the whole country (e.g., *Bufo marinus*, *Hyla crepitans*) compared to the punctual distribution of those tepui-associated taxa (e.g., *Oreophrynella huberi*, *O. vasquezi*), or the narrow distribution of dendrobatids in the Mérida Andes. Many examples of these are known in any biogeographical region.

The fast change in the Venezuelan landscapes will have a severe impact in the distribution of the herpetofauna. In less than half a century most forests in Region I have been cut down and replaced by prairies. Amphibian species prevail in the south, while reptiles dominate the north. In general, most, but mainly the xerophytic fauna, is shared with that of xeric Region III, a relationship extending to the rich and large valley of the Colombian Magdalena river. The valley of the Catatumbo river might have played a role in acting as a passway between the faunas of these regions.

The existence of many humid environments in the Andes (Region II) permits the presence of a large number of frog species (Duellman 1979; Péfaur and Díaz de Pascual 1982). This region has few biogeographical contacts with other parts of the country, although it has served as a passway for dispersing faunas (Péfaur and Pérez 1995; Rivero 1979; Rivero and Solano 1977). Something similar occurs in the wet and elevated lands of Region IV, the Coastal Range. The Andes do not have within them any important large geographical barrier, but there are rich microclimates that act as ecological refuges. In the Coastal Range region, however, there are at least two well differentiated kinds of lands: wet elevated and xerophytic lowlands close to the Caribbean Sea (Rivero 1964a; Manzanilla et al. 1995, 1996). Moreover, an important selective biogeographical barrier has acted in this region, as is the case of the Unare river valley, where many herpetofauna species distributions are discontinued past this point, such as *Colostethus mandelorum*, *L. insularum*, and *Eleutherodactylus terraebolivaris*, among others (Rivero 1964a; La Marca 1992).

In the Llanos (Region V) there exists a fairly large herpetological fauna, which is common with the other regions (Staton and Dixon 1977; Rivero-Blanco and Dixon 1979; Péfaur and Díaz de Pascual 1987). The Llanos are climatically and vegetationally homogeneous at the macrogeographical level, although they are intermingled with a web of riparian forest communicating with the other surrounding regions. Bordered by the Orinoco river in the south, this region does not separate faunistically from Regions VI and VII—the largest Venezuelan river seems not to be a selective biogeographical barrier for amphibians and reptiles (Rivero 1961).

The southern regions of Venezuela, Guayana and Amazonas (Regions VI and VII) are closer associated with the Amazonian sector of South America than with the northern areas of the country. The geological changes, the climate, the topography, and the diverse vegetation make these two areas the richest in herpetofauna species. This is especially true of the Guayana where a multitude of habitats facilitate the process of evolution. With the exception of salamanders and crocodilians, the taxa are more numerous in the Guayana, than in any other region. For the rest of the groups, the number is almost double in the Guayana, as compared to any of the other biogeographical regions. The ecological complexity of this region has played several roles in the evolution of the biota. On the one hand, it has constituted a selective barrier for the extension of some faunal elements from the Brazilian Amazonian lowlands to the Llanos of Venezuela and vice versa; on the other hand, it is the seat for many endemic species (Hoogmoed 1979; this study). At the same time, it has shared species with other regions of Venezuela and Brazil (Avila-Pires 1995). One particular exception is *Leptodactylus labyrinthicus*. This species lives north and south of this region, leaving a distributional hiatus in the Guayana shield (Péfaur and Sierra 1995).

Depending on the total number of species present in each region, three categories of regions can be proposed: a) those with less than 100 species, comprised by the Maracaibo Lake, the Lara-Falcón, and the Islands regions; b) those with more than 100 but less than 200 species, which includes the Andes, the Coastal Range, Llanos, and Amazonas; and c) with more than 300 species, represented by the Guayana region. Moreover, the limits of every biogeographical region, are very imprecise. For instance, there is a sector where Regions II, III, and V converge, and thus there is an uncertainty about the region to which some species belong. Another biogeographical nodule is the sector where Regions III and IV merge. There is greater need for a more detailed analysis of presence species in these conflicting sectors. On the other hand, collecting records are very scarce in the Cordillera de Perijá in western Venezuela and the Orinoco delta region in eastern Venezuela. It is possible that the Delta might be considered a separate biogeographical region when more biological information is gathered and analyzed.

Species-richness

The faunistic richness of an area would be better expressed by an Index of Species-Richness (SRI) that takes into account both the area and the number of species. In essence, this index is a species-density index—that is, at the same number of species, those biogeographical areas with small surfaces will have higher values in SRI than areas with larger surfaces. SRI numbers allow the comparison of any area or region of the world with respect to species-richness. In the case of Venezuela, its large size and the existence of extensive territories, such as the Llanos, with a low number of species, account for a low SRI value (0.06), similar to the one known for the Yucatán Peninsula in Mexico (Lee 1980). This statistical artifact warns about the use of such index for countries with a high diversity of landscapes, but to use it for particular regions on small countries. For instance, among published data, Oaxaca in Mexico has an SRI value of 0.37 and is usually considered one of the richest herpetological regions in the world (Casas-Andreu et al. 1996), whereas Costa Rica has been reported as having the largest SRI value (0.71) in the world (Johnson 1989).

If both amphibians and reptiles are analyzed together, the highest SRI value is found in the Andes, followed by the Falcón-Lara region. The SRI values of 0.34 and 0.32, respectively (Table 8), are distinguished even when compared to the SRI richest regions of the world. When the analysis is carried out separately for amphibian species, the Andes is the only region that stands out as the most diverse region. This relatively small area, with several elevational belts and an abundance of humidity and wet life zones, has a condensed density of amphibian species. In turn, when the reptile fauna is analyzed separately, the largest value is found in Region III (Falcón-Lara), which is also a small area covered with xerophytic vegetation—a fitting place for reptiles.

Faunistic similarity

Similarity is a concept that brings together biogeographical elements and evolutionary aspects of the fauna. In the comparison of the seven regions of Venezuela, all obtained values for amphibians are under 0.50, indicating a low degree of species shared between biogeographical regions. The most similar amphibian faunas are those of Regions IV-V and V-VII—the values of their similarity indexes are the highest (0.45 and 0.46, respectively). It is not a surprise to find these relationships, for there is a geographical continuity between these regions, but what is biogeographically relevant is the high similarity between the Llanos and the Maracaibo Lake region, which are separated by ranges and dry lands, but that share some species with disjunct distributions such as *Leptodactylus bolivianus*, *L. wagneri*, *Physalaemus pustulosus*, and *Pseudis paradoxa*, among others. On the other hand, elements of Region II differ considerably from the other areas, an indication of the greater amphibian independence of the Andes with respect to the other regions in Venezuela. A similar pattern is provided by the Guayana region, which exhibits an independence as a biotic source.

Because reptile species usually have a rather ample distribution, the number of shared species and the similarity values are higher in this group than in the amphibians. The overall similarity values are higher, especially between Regions VI and VII, and with the lowest level between the Andes and Amazonas. Considering the reptiles, the Andes does not stands out as a faunistically independent region because of this region's relatively strong relationships to the Maracaibo Lake and Falcón-Lara regions.

Endemism

The formation of new animal species, as the result of genetic and ecological processes, has been one of the major evolutionary features in many areas of Venezuela. Wherever the distribution of a species is reduced in space, an endemism process is at work.

Herpetological endemism is different in the several biogeographical zones of Venezuela. The Andes and the Guayana are the regions with the highest percentages of amphibian endemics, most of them *biological endemics*, reflecting an active speciation process, something that has been acknowledged in other animal groups (Brown et al. 1974). On one side, at the Andes there has been an active process of contraction and expansion of forests as consequence of the glaciation periods, and on the other side, at the Guayana, there has been an appearance of different vegetational formations oriented by a long history of erosive changes. In the Coastal Range almost half of the amphibian species are *biological endemics*, too. The fact that most amphibian endemics are found in elevated lands is evidence favoring the close relationship between abundance of life zones and diversity of amphibians. The Andes has 16 life zones, and both the Coastal Range and the Guayana regions have 10 each.

The situation is different with the reptiles. Though there are 119 species in the country considered as *biological* or *political endemics*, only one region has a greatest number of endemics, the Guayana, with 40% of their total species endemic. Reptiles are less restricted to a geographical place and have a wider ecological tolerance, thus extending their distributions into different

Table 9. Causes of amphibian population decline.

I. Environmental changes due to human activity	II. Environmental changes due to astronomic factors
a) Destruction and/or fragmentation of habitats	a) Global climatic changes
b) Agriculture frontier expansion	1) in temperature patterns
c) Inadequate use of plaguicides	2) in precipitation and relative humidity patterns
d) Water pollution	b) Ultraviolet radiation increases
e) Ozone's cover destruction or weakness	c) Not-yet-evaluated factors
f) Acid rain	1) Cosmic dust impact
g) Introduction of predator and/or competitor species	2) Micrometeors
h) Expansion and/or introduction of diseases	3) X-rays
	4) Gamma-rays


Plate 31

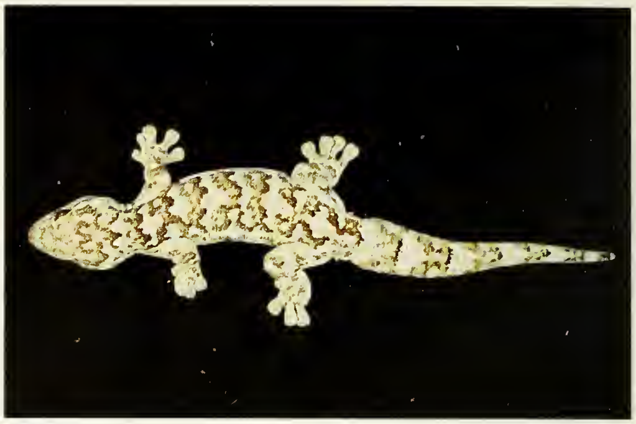
Plate 32


Plate 33


Plate 34


Plate 35


Plate 36


Plate 37

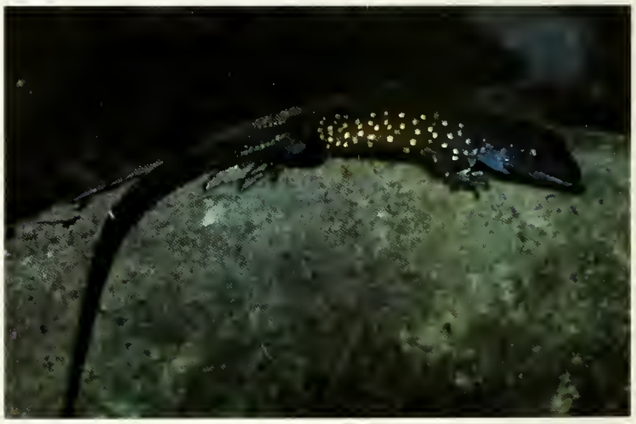
Plate 38

Plate captions: **31**. *Geochelone carbonaria*. A common and popular turtle. Most peasants rise this species as food and pet. Venezuela, Guárico. **32**. *Thecadactylus rapicaudus*. A gekkonid lizard with an ample distribution in the country. Venezuela, Mérida. **33**. *Norops nitens*. Venezuela, Guatopo. *Photo courtesy of Laurie J. Vitt.* **34**. *Polychrus marmoratus*. A chameleon-type lizard, common in the wet forests. Venezuela, Aragua. **35**. *Anadia bitaeniata*. A member of a taxonomically very complex group of lizards from the Andean páramos and cloud forests. Venezuela, Mérida. **36**. *Gymnophthalmus speciosus*. One of the smallest lizards; it lives in the litter of most types of forests. Venezuela, Mérida. **37**. *Ameiva bifrontata*. A medium sized lizard with an ample distribution in the lowlands. Venezuela, Táchira. **38**. *Cnemidophorus lemniscatus*. A ground dwelling lizard that probably has the largest distribution in all ecological zones of the country. Venezuela, Zulia.

regions and life zones within a region.

The Falcón-Lara and the Llanos have the smallest numbers of endemics in the country. These areas are macroenvironmentally homogenous, not favoring speciation as much as in heterogeneous elevated lands with unstable environments. Both regions do not have strong biogeographical barriers; this translates into a more extensive sharing of herpetological species between bordering regions. We hypothesize that any zoological taxa will have fewer endemic species in the lands of Falcón-Lara or the Llanos of Venezuela. The Maracaibo Lake Region is unusual, as the amphibian endemic numbers are quite low compared to the reptile endemic species and can be explained by the extensive dry lands. The finding of only a low number of amphibian endemics in Amazonas is probably due to insufficient research in its territory.

Exemplified by the literature, animal groups exhibit more endemics at elevated lands primarily due to isolation. For instance, when the mammalian fauna, bats excluded, is studied, the Andes region shows the largest percentage of endemic species of terrestrial mammals (Eisenberg and Redford 1979). Supposedly, any taxon closely associated with a geographical territory (as opposed to a loose association, as in bats, birds, flying insects, etc.) has experienced a high degree of speciation in the Andes, mainly due to the glaciation processes during the Pleistocene (Schubert and Vivas 1993) and the corresponding vegetational responses of expansion and contractions (Duellman 1982). A general review is needed, but the preliminary work by Díaz et al. (1997) seems to be an indication that this actually occurs.

Conservation

Venezuela has a human population with a high degree of environmental concern, but it is also a country with a rather strong push for development. This contradictory situation has statistical expressions in the high and rapid destruction of natural environments, with a rate of 600,000 ha of deforestation yearly and the existence, at the present time, of 43 National Parks, two Biosphere Reserves, and seven Wildlife Refuges (MARNR 1992). Such a great number of protected areas should help to conserve the herpetofauna within their limits.

Unfortunately, actual study cases on the decline of animal populations are few (Ojasti 1967; La Marca and Reinthaler 1991). Few documented cases are known where herpetological species have been known to be on the verge of extinction or have verifiable population declines. Undoubtedly, the large reptiles have been the most affected by an extractive commerce (e.g., collecting for the skin trade, meat consumption) developed prior to the 1980s when several regulations were established. Today strict regulations are in action to protect crocodiles and turtles.

Amphibians are also imperiled, as can be derived from the provided list of endangered species (Appendix 2). As in many other places of the world (Blaustein and Wake 1990), a decimation of amphibians population is occurring in the highlands of Venezuela. The loss or reduction of amphibian species may have some important ecological consequences, for they are crucial to food chains. Thus, the energy linkage, as well the predator and/or the prey populations would be altered. This ecological biodiversity impoverishment would carry a loss of genetic material of potential use as well as a waste of food and/or pharmacological resources. The only pattern found among most of the Venezuelan declining amphibian species is that a high number are found at elevation. Why this occurs is not totally understood but may be due to water contamination or higher UV radiation levels at elevation, thus exhibiting vulnerability of amphibian species to this region particularly (Blaustein et al. 1994). Many causes can be responsible for the amphibian and other vertebrate's decline, but most can be framed into two kinds of environmental changes: human activities and astronomic factors (Table 9; Péfaur 1993).

Many conservation problems are faced and intended to be solved at the international level and at the national level by different government offices. As a nation, Venezuela has participated in several international agreements to protect the environment and/or the fauna. Among the more important ones are the Biodiversity Convention and The Amazonic Cooperation Treaty, designed to protect large areas; and the Interamerican Agreement for Protection and Conservation of Sea Turtles, as well as the Freshwater Convention, which is concerned with quality and quantity of the resource, its basins, the area drained by a river and its branches, and its fauna. Projects to protect crocodiles (Gorzula 1985; Thornbjarnarson 1991; Velasco and Ayarzagüena 1995; Baquero de Pedret and Quero de Peña 1996; and many technical reports listed under Seijas 1993) or turtles (Licata et al. 1996) under the responsibility of the Venezuelan Ministry of the Environment (MARNR) should help ensure proper protection and preservation of these animals. At several Venezuelan university laboratories, there are projects studying the biological and ecological aspects of amphibian and reptile species providing grounds to protect these valuable resources. As a corollary, it is usually accepted wisdom that the better we know a fauna and its associated ecosystems, the better protection we can offer.

A list of imperiled species (this study), the existence of protected areas, together with management and scientific projects designed to protect Venezuela's amphibians and reptiles, and the increasing international concern for them, strengthen the hope of preserving its valuable herpetofauna populations, and other resources, for future generations.

Conclusions

The existence of elevated ranges, extensive forests, and a myriad of rivers and other aquatic habitats, makes Venezuela an environmental mosaic where a diverse fauna of 252 amphibians species and 299 reptiles species live. Each of the eight current biogeographical zones has a relatively numerous herpetofauna—the most diverse are the Guayana and the Andes, with 310 and 142 species, respectively.

Due to the large area covered by certain territories, such as the Llanos and Guayana, the obtained value for the country's Species-Richness Index is relatively low. However, the regions situated in northern Venezuela appear high in the worldwide species-richness ranking.

The similarity among the biogeographical regions is rather low when comparing shared amphibian species, but it is higher when comparing reptiles. Selective biogeographical barriers work mainly in the mountainous regions and are less effective in the ecological continuous landscape of the rest of the country. The higher amphibian similarity is found among the Llanos-Amazonas regions, while for the reptiles is found among the Guayana-Amazonas regions.

Endemism in amphibians develops more in elevated lands, such as in the Guayana, the Andes, and the Coastal Range. There are less endemic reptiles than amphibians, due to their greater ability to disperse. The area with more endemic reptiles

Plate 39

Plate 40

Plate 41

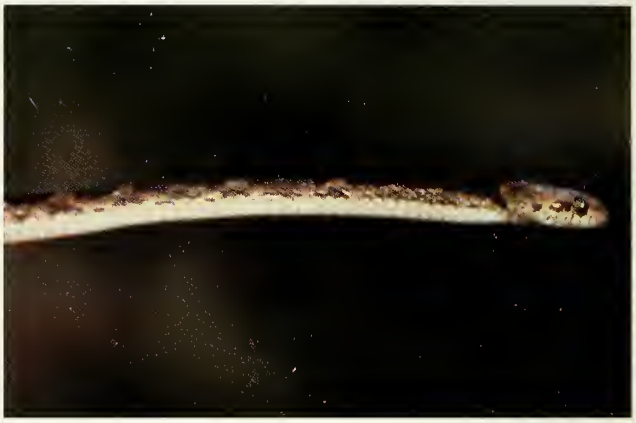

Plate 42

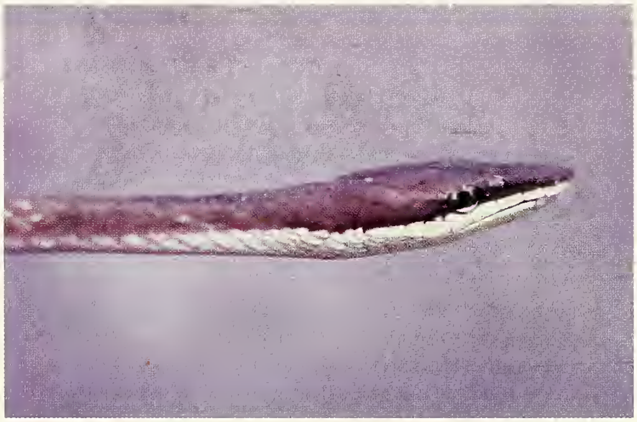

Plate 43

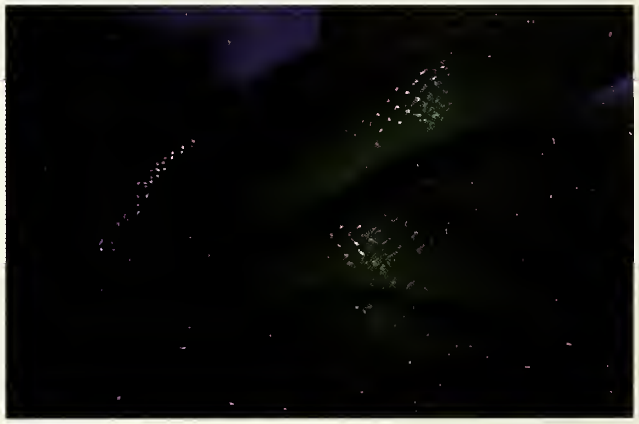

Plate 44

Plate 45

Plate 46

Plate captions: **39**. *Tupinambis teguixin*. The largest lizard of the country, is common in the Llanos and in the Lake Maracaibo zone. Venezuela, Zulia. **40**. *Leptotyphlops affinis*. This small ground dwelling snake, can be found in restricted parts of the Andean region. Venezuela, Mérida. **41**. *Helminthophis flavoterminatus*. This curious little snake distributes in many environments of the northwestern states. Venezuela, Mérida. **42**. *Leptodeira annulata*. This species is probably one of the most common snakes and the one with the largest distribution in northern South America. Venezuela, Táchira. **43**. *Oxybelis fulgidus*. This colored snake inhabits the southern lowlands. Venezuela, Bolívar. **44**. *Phylodryas viridissimus*. An attractive snake distributing in the southern states of the country. Venezuela, Bolívar. **45**. *Micrurus mipartitus*. Venezuela, Guatopo. *Photo courtesy of Laurie J. Vitt*. **46**. *Bothrops venezuelensis*. A large snake usually found in the forested environments of the northern mountains. Venezuela, Táchira.

is the Guayana region.

In terms of conservation, it is known that the more common environmental changes, destruction and fragmentation of habitats and agricultural expansion, will have severe consequences for the herpetofauna in Venezuela. As many species are endemics and restricted to small areas, the destruction of a few kilometers of the habitats could eliminate several species. The rapid destruction and/or contamination of natural environments are causing a decline in herpetofauna populations and numbers so as to put some species at extinction risk. Most imperiled amphibians are those living in the highlands of northern Venezuela, while the most endangered reptiles are the marine turtles, crocodilians, alligators, and turtles. It is hoped that the existence of several National Parks and other protected areas, and the increasing awareness of the citizens, would help to preserve the Venezuelan herpetofauna.

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APPENDIX 1: CHECKLIST OF VENEZUELAN AMPHIBIANS AND REPTILES

T A X A	Biogeographical zones*							
	I	II	III	IV	V	VI	VII	VIII
AMPHIBIA								
ANURA								
BUFONIDAE								
Atelopus carbonerensis Rivero 1972		■						
A. *chrysocorallus* La Marca 1996		■						
A. *cruciger* (Lichtenstein and Martens 1856)				■				
A. *mucubajiensis* Rivero 1974		■						
A. *oxyrhynchus* Boulenger 1903		■						
A. *pinangoi* Rivero 1980		■						
A. *sorianoi* La Marca 1983		■						
A. *tamaense* La Marca, Garcia, and Rengifo 1990		■						
Bufo ceratophrys Boulenger 1882						■	■	
B. *granulosus* Spix 1824	■	■		■	■	■	■	■
B. *guttatus* Schneider 1799						■	■	
B. *marinus* (Linnaeus 1758)	■	■	■	■	■	■	■	
B. *nasicus* Werner 1903						■		
B. *sternosignatus* Günther 1858			■	■	■			
B. *typhonius* (Linnaeus 1758)	■	■		■	■	■	■	
Metaphryniscus sosai Señaris, Ayarzagüena, and Gorzula 1994						■		
Oreophrynella cryptica Señaris 1993						■		
O. *huberi* Diego-Aransay and Gorzula 1987						■		
O. *macconnelli* Boulenger 1900						■		
O. *nigra* Señaris, Ayarzagüena, and Gorzula 1994						■		
O. *quelchii* (Boulenger 1895)						■		
O. *vasquezi* Señaris, Ayarzagüena, and Gorzula 1994						■		
CENTROLENIDAE								
Centrolene altitudinalis (Rivero 1968)		■						
C. *andinum* (Rivero 1968)		■						
C. *buckleyi* (Boulenger 1882)		■						
C. *gorzulai* (Ayarzagüena 1992)						■		
C. *lentiginosum* (Rivero 1985)		■						
Cochranella auyantepuiana (Señaris and Ayarzagüena 1993)						■		
C. *duidaeana* (Ayarzagüena 1992)						■		
C. *riveroi* (Ayarzagüena 1992)						■		
Hyalinobatrachium anthisthenesi (Goin 1963)				■				
H. *duranti* (Rivero 1985)		■						
H. *fleischmanni* (Boettger 1893)		■	■	■				
H. *fragilis* (Rivero 1985)				■				
H. *helenae* (Ayarzagüena 1992)						■		
H. *iaspidiensis* (Ayarzagüena 1992)						■		
H. *loreocarinatum* (Rivero 1985)		■						
H. *orientalis* (Rivero 1968)				■		■		
H. *ostracodermoides* (Rivero 1985)		■						
H. *pallidum* (Rivero 1985)		■						
H. *pleurolineatum* (Rivero 1985)		■						
H. *revocatum* (Rivero 1985)				■				
H. *taylori* (Goin 1967)						■		
DENDROBATIDAE								
Aromobates nocturnus Myers, Paolillo, and Daly 1991		■						
Colostethus bromelicola (Test 1956)				■				
C. *brunneus* (Cope 1887)			■	■		■	■	
C. *capurinensis* Péfaur 1993		■						
C. *dunni* (Rivero 1961)				■				
C. *humilis* Rivero 1978		■						
C. *leopardalis* Rivero 1976		■						
C. *mandelorum* (Schmidt 1932)				■				
C. *parkerae* Meinhardt and Parmelee 1996						■		
C. *saltuensis* Rivero 1978		■						
C. *sanmartini* Rivero, Langone, and Prigioni 1986						■		
C. *shrevei* (Rivero 1961)							■	
Dendrobates leucomelas Steindachner 1864						■	■	
D. *rufulus* Gorzula 1990						■		
Epipedobates pictus (Tschudi 1938)						■		
E. *trivittatus* (Spix 1824)						■	■	
Mannophryne collaris (Boulenger 1912)		■			■			
M. *cordilleriana* La Marca 1994		■						
M. *herminae* (Boettger 1893)				■				
M. *larandina* (Yústiz 1991)		■						
M. *neblina* (Test 1956)				■				
M. *oblitterata* (Rivero 1984)				■				
M. *riveroi* (Donoso-Barros 1965)				■				
M. *trinitatis* (Garman 1887)				■				
M. *yustizi* (La Marca 1989)		■						
Minyobates steyermarki (Rivero 1971)							■	
Nephelobates alboguttatus (Boulenger 1903)		■						
N. *duranti* (Péfaur 1985)		■						
N. *haydeeae* (Rivero 1976)		■						
N. *mayorgai* (Rivero 1978)		■						
N. *meridensis* (Dole and Durant 1972)		■						
N. *molinarii* (La Marca 1985)		■						
N. *orostoma* (Rivero 1976)		■						
N. *serranus* (Péfaur 1985)		■						
HYLIDAE								
Aparasphenodon venezolanus (Mertens 1950)						■		
Flectonotus fitzgeraldi Parker 1934				■				
F. *pygmaeus* (Boettger 1893)		■	■	■				
Gastrotheca helenae Dunn 1944		■						
G. *nicefori* Gaige 1933		■						
G. *ovifera* (Weinland 1854)				■				
G. *walkeri* Duellman 1980				■				
G. *williamsoni* Gaige 1922				■				
Hyla albomarginata Spix 1824	■			■				
H. *albopunctata* Spix 1824						■		
H. *alemani* Rivero 1964				■				
H. *aromatica* Ayarzagüena and Señaris 1993						■		
H. *battersbyi* Rivero 1961				■				
H. *benitezi* Rivero 1961						■		
H. *boans* (Linnaeus 1758)					■	■	■	
H. *calcarata* Troschel 1848							■	
H. *crepitans* Wied 1824	■	■	■	■	■	■	■	
H. *geographica* Spix 1824						■		
H. *granosa* Boulenger 1882						■	■	
H. *inparquesi* Ayarzagüena and Señaris 1993						■		
H. *jahni* Rivero 1961		■						
H. *kanaima* Goin and Woodley 1969						■		

*Shading represents presence of particular species within the respective biogeographical zone.

H. lanciformis (Cope 1870)								
H. lascinia Rivero 1969								
H. lemai Rivero 1972								
H. loveridgei Rivero 1961								
H. luteocellata Roux 1927								
H. marmorata (Laurenti 1768)								
H. meridensis (Rivero 1961)								
H. microcephala Cope 1886								
H. minuscula Rivero 1971								
H. minuta Peters 1872								
H. multifasciata Günther 1858								
H. pelidna Duellman 1989								
H. platydactyla Boulenger 1905								
H. pugnax Schmidt 1857								
H. punctata (Schneider 1799)								
H. roraima Duellman and Hoogmoed 1992								
H. sibleszi Rivero 1972								
H. vigilans Solano 1971								
H. warreni Duellman and Hoogmoed 1992								
H. wavrini Parker 1936								
Osteocephalus ayarzagüenai Gorzula [sic] and Señaris 1996								
O. buckleyi (Boulenger 1882)								
O. leprieurii (Dumeril and Bibron 1831)								
O. taurinus Steindachner 1862								
Phrynohyas venulosa (Laurenti 1768)								
Phyllomedusa bicolor (Boddaert 1772)								
P. hypocondrialis (Daudin 1803)								
P. medinai Funkhouser 1962								
P. tarsius (Cope 1868)								
P. tomopterna (Cope 1868)								
P. trinitatis Mertens 1926								
Scinax baumgardneri (Rivero 1961)								
S. boesemani (Goin 1966)								
S. boulengeri (Cope 1887)								
S. danae (Duellman 1986)								
S. exiguus (Duellman 1986)								
S. garbei (Miranda-Ribeiro 1926)								
S. kennedyi (Pyburn 1973)								
S. nebulosus (Spix 1824)								
S. rostratus (Peters 1863)								
S. ruber (Laurenti 1768)								
S. trilineatus (Hoogmoed and Gorzula 1979)								
S. x-signatus (Spix 1824)								
Sphaenorhynchus lacteus (Daudin 1801)								
Stefania evansi (Boulenger 1904)								
S. ginesi Rivero 1966								
S. goini Rivero 1966								
S. marahuaquensis (Rivero 1961)								
S. riae Duellman and Hoogmoed 1984								
S. scalae Rivero 1970								
Tepuihyla aecii Ayarzagüena, Señaris, and Gorzula 1992								
T. edelcae Ayarzagüena, Señaris, and Gorzula 1992								
T. galani Ayarzagüena, Señaris, and Gorzula 1992								
T. luteolabris Ayarzagüena, Señaris, and Gorzula 1992								
T. rimarum Ayarzagüena, Señaris, and Gorzula 1992								
T. rodriguezi (Rivero 1968)								

ALLOPHRYNIDAE								
Allophryne ruthveni Gaige 1926								
LEPTODACTYLIDAE								
Adelophryne gutturosa Hoogmoed and Lescure 1984								
Adenomera andreae (Muller 1923)								
A. hylaedactyla (Cope 1868)								
Ceratophrys calcarata Boulenger 1890								
C. cornuta (Linnaeus 1758)								
Dischidodactylus duidensis (Rivero 1968)								
D. colonnelloi Ayarzagüena 1983								
Eleutherodactylus anotis Walker and Test 1955								
E. bicumulus (Peters 1863)								
E. boconoensis Rivero and Mayorga 1973								
E. briceni (Boulenger 1903)								
E. cantitans Myers and Donnelly 1996								
E. chlorosoma Rivero 1982								
E. colostichos La Marca and Smith 1982								
E. cornutus (Jiménez de la Espada 1871)								
E. ginesi (Rivero 1964)								
E. johnstonei Barbour 1914								
E. lancinii Donoso-Barros 1968								
E. lentiginosus Rivero 1982								
E. marmoratus (Boulenger 1900)								
E. maussi (Boettger 1893)								
E. melanoproctus Rivero 1982								
E. mondolfii Rivero 1982								
E. nicefori Cochran and Goin 1970								
E. paramerus Rivero 1982								
E. pleurostriatus Rivero 1982								
E. prolixodiscus Lynch 1978								
E. pruinatus Myers and Donnelly 1996								
E. pulidoi Rivero 1982								
E. pulvinatus Rivero 1968								
E. reticulatus Walker and Test 1955								
E. riveroi Lynch and La Marca 1993								
E. rozei Rivero 1961								
E. stenodiscus Walker and Test 1955								
E. terraebolivaris Rivero 1961								
E. tubernasus Rivero 1982								
E. turumiquirensis Rivero 1961								
E. urichi (Boettger 1894)								
E. vanadise La Marca 1984								
E. vilarsi (Melin 1941)								
E. yaviensis Myers and Donnelly 1996								
E. zeuctotylus Lynch and Hoogmoed 1977								
Leptodactylus bolivianus Boulenger 1898								
L. diedrus Heyer 1994								
L. fuscus (Schneider 1799)								
L. insularum Barbour 1906								
L. knudseni Heyer 1972								
L. labialis (Cope 1877)								
L. labyrinthicus (Spix 1824)								
L. leptodactyloides (Andersson 1945)								
L. lithonaetes Heyer 1996								
L. longirostris Boulenger 1882								

	1	2	3	4	5	6	7	8
L. macrosternum Miranda-Ribeiro 1926	■				■	■		
L. mystaceus (Spix 1824)						■		■
L. pallidirostris Lutz 1930				■	■	■	■	■
L. pentadactylus (Laurenti 1768)						■	■	
L. petersii (Steindachner 1864)						■	■	
L. poecilochilus (Cope 1862)		■	■					
L. rhodomystax Boulenger 1883						■	■	
L. riveroi Heyer and Pyburn 1983							■	
L. rugosus Noble 1923						■	■	
L. sabanensis Heyer 1994						■		
L. wagneri (Peters 1862)	■	■			■	■		
Lithodytes lineatus (Schneider 1799)		■				■		
Physalaemus enesefae Heatwole, Solano, and Heatwole 1965					■	■		
P. fischeri (Boulenger 1896)						■		
P. pustulosus (Cope 1964)	■	■		■	■	■	■	
Pleurodema brachyops (Cope 1868)			■	■	■	■		■
Pseudopaludicola boliviana Parker 1927						■		
P. llanera Lynch 1989					■	■		
P. pusilla (Ruthven 1916)	■							
MICROHYLIDAE								
Adelastes hylonomus Zweifel 1986							■	
Ctenophryne geayi Mocquard 1904						■	■	
Elachistocleis ovalis (Schneider 1979)			■	■	■	■		
E. surinamensis (Daudin 1802)						■		
Otophryne robusta Boulenger 1900						■		
PIPIDAE								
Pipa arrabali Izecksohn 1976						■		
P. aspera Müller 1924						■		
P. parva Ruthven and Gaige 1923	■		■					
P. pipa (Linnaeus 1758)					■	■	■	
RANIDAE								
Rana palmipes Spix 1824		■		■	■	■	■	
PSEUDIDAE								
Pseudis paradoxa (Linnaeus 1758)	■				■	■	■	
CAUDATA								
PLETHODONTIDAE								
Bolitoglossa borburata Trapido 1942				■				
B. orestes Brame and Wake 1962		■						
GYMNOPHIONA								
CAECILIAIDAE								
Caecilia flavopunctata Roze and Solano 1963				■				
C. gracilis Shaw 1802						■		
C. subnigricans Dunn 1942		■	■					
C. tentaculata Linnaeus 1758		■				■		
Microcaecilia rabei (Roze and Solano 1963)						■		
Siphonops annulatus (Mikan 1820)						■		
RHINATREMATIDAE								
Epicrionops niger (Dunn 1942)						■		
TYPHLONECTIDAE								
Nectocaecilia petersii (Boulenger 1882)							■	

	1	2	3	4	5	6	7	8
Potomotyphlus kaupii (Berthold 1859)								
Typhlonectes compressicauda (Dumeril and Bibron 1841)								
T. natans (Fisher 1879)	■							
T. venezuelense Fuhrmann 1914	■			■				
REPTILIA								
TESTUDINES								
PELOMEDUSIDAE								
Podocnemis erythrocephala (Spix 1824)					■	■	■	
P. expansa (Schweigger 1812)				■	■	■	■	
P. lewyana Dumeril 1852	■							
P. unifilis Troschel 1848					■	■	■	
P. vogli Müller 1935		■		■	■	■		
Peltocephalus dumerilianus (Schweigger 1812)							■	
CHELYIDAE								
Chelus fimbriatus (Schneider 1783)				■	■	■	■	
Phrynops (Phrynops) geoffroanus (Schweigger 1812)						■		
P. (Mesoclemmys) gibbus (Schweigger 1912)					■	■	■	
P. (Batrachemys) nasutus (Schweigger 1912)						■		
P. zuliae Pritchard and Trebbau 1984	■							
EMYDIDAE								
Platemys platycephala (Schneider 1792)						■	■	
Rhinoclemmys diademata (Mertens 1954)	■							
R. punctularia (Daudin 1801)					■	■	■	
Trachemys scripta (Gray 1855)	■		■	■				
TESTUDINIDAE								
Geochelone (Chelonoides) carbonaria (Spix 1824)	■		■	■	■	■	■	
G. denticulata (Linnaeus 1766)						■	■	■
KINOSTERNIDAE								
Kinosternon scorpioides (Linnaeus 1766)	■		■	■	■	■	■	
DERMOCHELYIDAE								
Dermochelys coriacea (Linnaeus 1766)								■
CHELONIIDAE								
Chelonia mydas (Linnaeus 1758)								■
Caretta caretta (Linnaeus 1758)								■
Eretmochelys imbricata (Linnaeus 1766)								■
Lepidochelys olivacea (Eschscholz 1829)								■
CROCODYLIA								
CROCODYLIDAE								
Crocodylus acutus (Cuvier 1807)			■	■				
C. intermedius Graves 1819					■	■	■	■
ALLIGATORIDAE								
Caiman crocodilus Linnaeus 1758	■			■	■	■	■	
Caiman niger Linnaeus 1758							■	
Paleosuchus palpebrosus (Cuvier 1807)						■	■	
P. trigonatus (Schneider 1801)							■	
AMPHISBAENIA								
AMPHISBAENIDAE								

Amphisbaena alba Linnaeus 1758
A. fuliginosa Linnaeus 1758
A. gracilis (Strauch 1881)
A. rozei Lancini 1963
A. spurrelli Boulenger 1915
Mesobaena huebneri Mertens 1925
LACERTILIA
SCINCIDAE
Mabuya bistriata (Spix 1825)
M. carvalhoi Rebouças-Spieker and Vanzolini 1990
M. croizati Horton 1973
M. mabouya (Lacépède 1788)
GEKKONIDAE
Coleodactylus amazonicus (Anderson 1918)
C. septentrionalis Vanzolini 1980
Gonatodes albogularis (Dumeril and Bibron 1836)
G. annularis Boulenger 1887
G. antillensis (Van Lidth de Jeude 1887)
G. bodinii Rivero-Blanco 1964
G. ceciliae Donoso-Barros 1966
G. concinnatus (O'Shaughnessy 1881)
G. falconensis Shreve 1947
G. humeralis (Guichenot 1855)
G. ocellatus (Gray 1831)
G. petersi Donoso-Barros 1967
G. seigliei Donoso-Barros 1966
G. taniae Roze 1963
G. vittatus (Lichtenstein 1856)
Hemidactylus mabouia (Moreau de Jonnes 1818)
H. palaichthus Kluge 1969
Lepidoblepharis montecanoensis Markezich and Taphorn 1994
Phyllodactylus dixoni Rivero-Blanco and Lancini 1967
P. ventralis O'Shaughnessy 1875
Pseudogonatodes guianensis Parker 1935
P. lunulatus (Roux 1927)
Sphaerodactylus molei Boettger 1894
Thecadactylus rapicaudus (Houttuyn 1782)
CORYTOPHANIDAE
Basiliscus basiliscus (Linnaeus 1758)
IGUANIDAE
Iguana iguana (Linnaeus 1758)
POLYCHROTIDAE
Dactyloa frenata (Cope 1899)
D. jacare (Boulenger 1903)
D. nigropunctata (Williams 1974)
D. punctata (Daudin 1802)
D. roquet (Bonnaterre 1789)
D. squamulata (Peters 1863)
D. tigrina (Peters 1863)
D. transversalis (Dumeril 1851)
Norops annectens (Williams 1974)
N. auratus Daudin 1802
N. biporcatus (Wiegmann 1834)
N. deltae (Williams 1974)
N. fuscoauratus (Dumeril and Bibron 1837)
N. gibbiceps (Cope 1864)
N. nitens (Wagler 1830)
N. onca O'Shaughnessy 1875
N. sagrei (Dumeril and Bibron 1837)
N. tropidogaster (Hallowell 1857)
Phenacosaurus bellipeniculus Myers and Donnelly 1996
P. carlostoddi Pradeiro 1996
P. euskalerriari Barros, Williams, and Viloria 1996
P. neblininus Myers, Williams, and McDiarmid 1993
P. nicefori Dunn 1944
P. tetarii Barros, Williams, and Viloria 1996
Polychrus marmoratus (Linnaeus 1758)
TROPIDURIDAE
Tropidurus azureum (Linnaeus 1758)
T. bogerti Roze 1958
T. hispidus (Spix 1825)
T. lumaria Donnelly and Myers 1991
T. plica (Linnaeus 1758)
T. umbra (Linnaeus 1758)
Uranoscodon superciliosum (Linnaeus 1758)
GYMNOPHTHALMIDAE
Anadia bitaeniata Boulenger 1903
A. blakei Schmidt 1932
A. bogotensis (Peters 1862)
A. brevifrontalis (Boulenger 1903)
A. hobarti La Marca and García-Pérez 1990
A. marmorata (Gray 1846)
A. pamplonensis Dunn 1944
A. steyeri Nieden 1914
Arthrosaura reticulata (O'Shaughnessy 1881)
A. synaptolepis Donnelly, McDiarmid, and Myers 1992
A. tyleri (Burt and Burt 1931)
A. versteegii Van Lidth de Jeude 1904
Bachia bicolor (Cope 1896)
B. flavescens (Bonaterre 1789)
B. guianensis Hoogmoed and Dixon 1977
B. heteropa Lichtenstein 1856
B. monodactyla (Daudin 1802)
Cercosaura ocellata Wagler 1830
Euspondylus acutirostris (Peters 1862)
E. goeleti Myers and Donnelly 1996
E. phelpsorum Lancini 1968
Gymnophthalmus cryptus Hoogmoed, Cole, and Ayarzagüena 1992
G. speciosus (Hallowell 1861)
G. underwoodi Grant 1958
Leposoma percarinatum (Müller 1923)
Neusticurus bicarinatus (Linnaeus 1758)
N. racenisi Roze 1958
N. rudis Boulenger 1900
N. tatei (Burt and Burt 1931)
Prionodactylus ampuedai (Lancini 1968)
Proctoporus achlyens Uzzell 1958

P. cephalolineatus García-Pérez and Yústiz 1995		■						
P. luctuosus (Peters 1862)				■				
Ptychoglossus kugleri Roux 1927			■	■				
P. brevifrontalis (Boulenger 1912)						■		
Riolama leucostictus (Boulenger 1900)						■		
Tretioscincus bifasciatus (Dumeril 1851)	■		■					■
T. oriximinensis Avila-Pires 1995						■	■	
TEIIDAE								
Ameiva ameiva (Linnaeus 1758)	■	■		■	■	■	■	■
A. bifrontata Cope 1862	■	■	■	■		■		■
Cnemidophorus cryptus Cole and Dessauer 1993						■		
C. lemniscatus (Linnaeus 1758)	■	■	■	■	■	■	■	■
C. gramivagus McCrystal and Dixon 1987					■			
C. nigricolor Peters 1873								■
Crocodilurus lacertinus (Daudin 1802)							■	
Kentropyx altamazonica Cope 1876							■	
K. borckiana Peters 1869						■		
K. calcarata Spix 1825						■	■	
K. pelviceps Cope 1868							■	
K. striata (Daudin 1802)					■	■	■	
Tupinambis teguixin (Linnaeus 1758)	■		■	■	■	■	■	
SERPENTES								
BOIDAE								
Boa constrictor Linnaeus 1758	■	■	■	■	■	■	■	■
Corallus caninus (Linnaeus 1758)					■	■	■	■
C. hortulanus (Linnaeus 1758)	■	■	■	■	■	■	■	■
Epicrates cenchria (Linnaeus 1758)	■	■	■	■	■	■	■	■
Eunectes murinus Linnaeus 1758	■		■	■	■	■	■	■
ANILIIDAE								
Anilius scytale Roze 1958						■	■	
LEPTOTYPHLOPIDAE								
Leptotyphlops affinis (Boulenger 1884)		■						
L. albifrons (Wagler 1824)				■				■
L. amazonicus Orejas-Miranda 1969							■	
L. dimidiatus (Jan 1861)						■	■	
L. goudotti (Dumeril and Bibron 1854)	■		■	■				■
L. macrolepis (Peters 1857)			■	■		■		
L. septemstriatus (Schneider 1801)						■		
L. tenellus Klauber 1939						■		
ANOMALEPIDAE								
Helminthophis flavoterminatus (Peters 1857)	■	■	■	■				
Liotyphlops albirostris (Peters 1881)	■			■				
TYPHLOPIDAE								
Typhlops brongersmianus Vanzolini 1972				■		■	■	
T. lehneri Roux 1926			■					
T. minuisquamus Dixon and Hendricks 1979						■	■	
T. reticulatus (Linnaeus 1758)			■	■			■	
COLUBRIDAE								
Atractus badius (Boie 1827)		■		■		■		
A. duidensis Roze 1961						■		
A. elaps (Günther 1858)						■	■	

A. eniqdioi González-Sponga 1971		■						
A. erythromelas Boulenger 1903		■						
A. fuliginosus (Hallowell 1845)				■				
A. insipidus Roze 1961								
A. lancinii Roze 1967				■				
A. major Boulenger 1894								
A. mariselae Lancini 1969		■						
A. riveroi Roze 1961						■		
A. steyermarki Roze 1958						■		
A. trilineatus Wagler 1828				■	■	■		
A. univittatum (Jan 1862)				■				
A. ventrimaculatus Boulenger 1905		■						
A. vittatus Boulenger 1894				■				
Chironius carinatus (Linnaeus 1758)	■	■	■	■	■	■	■	
C. exoletus (Linnaeus 1758)					■	■	■	
C. fuscus (Linnaeus 1758)			■	■	■	■	■	
C. monticola Roze 1952		■		■				
C. multiventris Schmidt and Walker 1943				■		■	■	
C. scurrulus (Wagler 1824)				■		■	■	
Clelia clelia (Daudin 1803)	■	■	■	■	■	■	■	
Dendrophidion dendrophis (Schlegel 1837)				■	■	■	■	
D. nuchalis (Peters 1864)	■			■				
Dipsas catesbyi (Sentzen 1796)						■	■	
D. copei (Günther 1872)						■		
D. latifrontalis (Boulenger 1905)		■						
D. pavonina Schlegel 1837						■	■	
D. perijanensis (Alemán 1953)	■							
D. variegata (Dumeril, Bibron, and Dumeril 1854)			■	■		■	■	
Drymarchon corais (Boie 1827)	■	■	■	■	■	■	■	■
Drymobius rhombifer (Günther 1860)	■	■		■	■	■	■	
Drymoluber dichrous (Peters 1863)						■	■	
Erythrolamprus aesculapii (Linnaeus 1758)						■	■	
E. bizona Jan 1863		■	■	■				
E. pseudocorallus Roze 1959	■							
Helicops angulatus (Linnaeus 1758)		■		■	■	■	■	
H. hagmanni Roux 1910						■		
H. hogei Lancini 1964						■	■	
H. leopardinus Schlegel 1837						■	■	
H. pastazae Shreve 1934	■							
H. scalaris Jan 1865	■							
Hydrodynastes bicinctus (Herrmann 1804)						■	■	
Hydrops triangularis (Wagler 1824)					■	■	■	
Imantodes cenchoa (Linnaeus 1758)	■	■	■	■	■	■	■	
I. lentiferus (Cope 1894)					■	■	■	
Lampropeltis triangulum (Cope 1860)	■	■		■				
Leptodeira annulata (Linnaeus 1785)	■	■	■	■	■	■	■	■
L. bakeri (Ruthven 1936)			■					
L. septentrionalis (Kennicott 1859)	■			■				
Leptophis ahaetulla (Günther 1859)	■		■	■	■	■	■	■
Liophis breviceps Cope 1860						■	■	
L. cobellus (Linnaeus 1758)						■		
L. epinephalus Cope 1862		■						
L. lineatus (Linnaeus 1758)			■	■	■	■	■	
L. melanotus (Shaw 1802)	■	■	■	■	■	■		■
L. poecilogyrus (Wied 1825)						■		
L. reginae (Linnaeus 1758)	■	■	■	■		■	■	

L. torrenticola Donnelly and Myers 1991								
L. typhlus (Linnaeus 1758)								
L. williamsi (Roze 1958)								
Masticophis mentovarius Dumeril, Bibron, and Dumeril 1854								
Mastigodryas amarali (Stuart 1938)								
M. bifossatus Raddi 1820								
M. boddaerti (Sentzen 1796)								
M. pleei (Dumeril, Bibron, and Dumeril 1854)								
Ninia atrata (Hallowell 1845)								
Oxybelis aeneus Wagler 1824								
O. fulgidus (Daudin 1803)								
Oxyrhopus petola (Linnaeus 1758)								
O. trigeminus Dumeril, Bibron, and Dumeril 1854								
O. venezuelanus Shreve 1947								
Philodryas cordata Donnelly and Myers 1991								
P. olfersii (Lichtenstein 1823)								
P. viridissimus (Linnaeus 1758)								
Phimophis guianensis (Troschel in Schomburgk 1848)								
Pseudoboa coronata Schneider 1801								
P. neuwiedi (Dumeril, Bibron, and Dumeril 1854)								
Pseudoeryx plicatilis (Linnaeus 1758)								
Pseustes poecilonotus (Günther 1858)								
P. shropshirei (Barbour and Amaral 1924)								
P. sulphureus (Wagler 1824)								
Rhinobothryum bovalli Anderson 1926								
R. lentiginosus (Scopoli 1785)								
Sibon nebulata (Linnaeus 1758)								
Spilotes pullatus (Linnaeus 1758)								
Stenorhina degenhardtii (Berthold 1846)								
Taeniophallus brevirostris (Peters 1863)								
Tantilla melanocephala (Linnaeus 1758)								
T. semicincta (Dumeril, Bibron, and Dumeril 1854)								
Thamnodynastes chimanta Roze 1958								
T. corocoroensis Gorzula and Ayarzagüena 1995								
T. duida Myers and Donnelly 1996								
T. marahuaquensis Gorzula and Ayarzagüena 1995								
T. pallidus (Linnaeus 1758)								
T. strigilis (Thunberg 1787)								
T. yavi Myers and Donnelly 1996								
Tripanurgos compressus (Daudin 1803)								
Umbrivaga mertensi Roze 1803								
Urotheca multilineata (Peters 1859)								
Xenodon rabdocephalus (Wied 1824)								
X. severus (Linnaeus 1758)								
Xenoxybelis argenteus (Daudin 1803)								
ELAPIDAE								
Leptomicrurus collaris (Schlegel 1837)								
Micrurus circinalis (Dumeril and Bibron 1854)								
M. dissoleucus (Cope 1860)								
M. dumerili (Jan 1858)								
M. hemprichi (Jan 1858)								
M. isozonus (Cope 1860)								
M. lemniscatus (Linnaeus 1758)								
M. meridensis Roze 1989								
M. nipartitus (Dumeril, Bibron, and Dumeril 1854)								
M. psyches (Daudin 1803)								

M. remotus Roze 1987								
M. spixi Wagler 1824								
M. surinamensis (Cuvier 1817)								
VIPERIDAE								
Bothriechis schlegelii (Berthold 1846)								
Bothriopsis bilineata (Wied 1821)								
B. medusa Sternfeld 1920								
B. taeniata (Wagler 1824)								
Bothrops asper (Gasman 1883)								
B. atrox (Linnaeus 1758)								
B. brazili Hoge 1953								
B. eueydae Sandner-Montilla 1976								
B. isabelae Sandner-Montilla 1979								
B. venezuelensis Sandner-Montilla 1952								
Crotalus pifanorum Sandner-Montilla 1980								
C. durissus Linnaeus 1758								
Lachesis muta (Linnaeus 1766)								
Porthidium lansbergii (Schlegel 1841)								

Caiman crocodilus. This large crocodile is common in most waters in the lowlands of Venezuela and other surrounding countries. Venezuela, Apure.

APPENDIX 2: CHECKLIST OF ENDANGERED VENEZUELAN AMPHIBIANS AND REPTILES

CLASS	ORDER	FAMILY	SPECIES
AMPHIBIA			
	Anura		
		Allophrynidae	
			Allophryne ruthveni
		Bufonidae	
			Atelopus carbonerensis
			A. cruciger
			A. mucubajiensis
			A. oxyrhynchus
			*A. sorianoi**
			Oreophrynella huberi
			O. macconelli
		Centrolenidae	
			*Centrolene altitudinalis**
			*C. andinus**
			*Hyalinobatrachium duranti**
			*H. pleurolineatum**
		Dendrobatidae	
			*Colostethus capurinensis**
			C. humilis
			C. leopardalis
			C. mandelorum
			C. saltuensis
			Mannophryne collaris
			*M. cordillerana**
			Nephelobates alboguttatus
			N. duranti
			N. haydeeae
			N. mayorgai
			N. meridensis
			*N. molinarii**
			N. orostoma
			N. serranus
		Hylidae	
			*Gastrotheca nicefori**
			Hyla jahni
			H. lascinia
			*H. meridensis**
			H. platydactyla
		Leptodactylidae	
			Ceratophrys calcarata
			C. cornuta
			*Leptodactylus labyrinthicus**
			Eleutherodactylus ginesi
			E. lancinii
			E. paramerus
			*Pseudopaludicola pusilla**
	Caudata		
		Plethodontidae	
			Bolitoglossa borburata
			B. orestes
REPTILIA			
	Testudines		
		Pelomedusidae	
			Podocnemis expansa
			*P. lewyana**
		Dermochelyidae	
			Dermochelys coriacea
		Chelonidae	
			Caretta caretta
			Chelonia mydas
			Eretmochelys imbricata
			Lepidochelys olivacea
	Crocodylia		
		Crocodylidae	
			Crocodylus acutus
			C. intermedius
		Alligatoridae	
			*Caiman niger**

**Additions to the previous report to DAPTF/SSC/IUCN.*

Colostethus, Venezuela: Guatopo National Park. *Photo courtesy of Janalee P. Caldwell.*


Plate 47


Plate 48


Plate 49


Plate 50

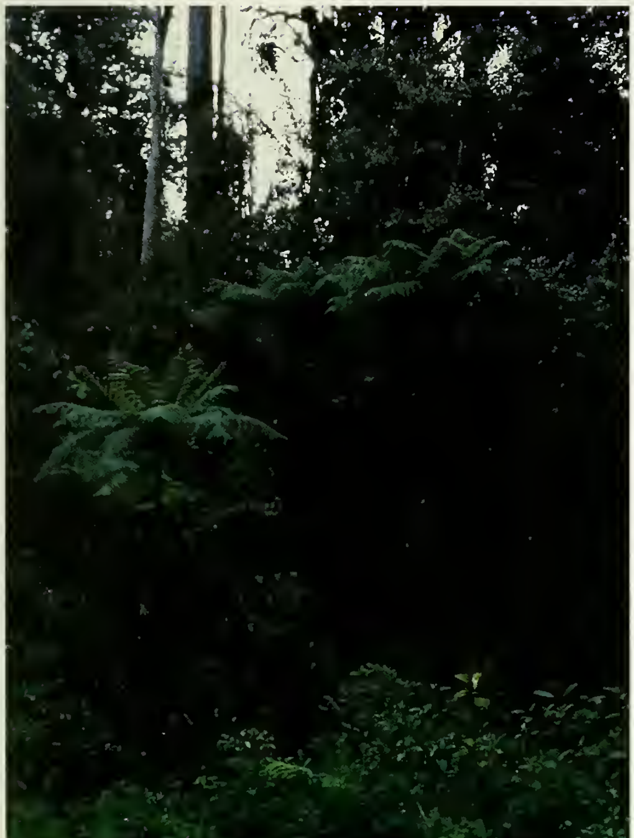
Plate 51


Plate 52

Plate captions: **47**. The Venezuelan Andes. The versants of the mountains are covered with lush forests, mainly of cloud type; at the top, the páramo develops. The Bolívar Peak, covered by ice, is the highest point in the country. Venezuela, Mérida. **48**. Coastal Range in north-central Venezuela. The northern tradewinds dry up the sea-facing environments producing a semixeric or xeric ecosystem. Venezuela, Aragua. **49**. The Llanos of Venezuela is one of the largest and more homogeneous biomes of the country. These flatlands develop between the Andes and the Coastal Range to the north, and the Apure–Orinoco rivers to the south. Venezuela, Barinas. **50**. In the Venezuelan Guayana appears the tepuis, isolates tabletop mountains, that dominated the landscape. The lower lands are covered by prairies, as the Gran Sabana, or by forests, as the largest part of the states of Bolívar and Amazonas. Venezuela, Bolívar. **51**. A view of the inside of San Eusebio cloud forest, in the Venezuelan Andes. Tree ferns and bromelids are characteristics. Venezuela, Mérida. **52**. Where dense clouds coming from the Caribbean Sea hit the mountains, a dense cloud forest appears at the upper parts of the Coastal Range. One of the best known is Rancho Grande, on the road from Maracay to Ocumare. Venezuela, Aragua.

Plate 53. The páramos appear at the highest points in the Andes, from Venezuela to Ecuador. Pictured above, the Piedras Blancas Páramo at the top of the Mérida Andes, about 4200 m. Venezuela, Mérida

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Cover: *Cuora galbinifrons*, Diaoluoshan, 18 km N. of Nanxi, Hainan Province, China. Photo by James F. Parham.

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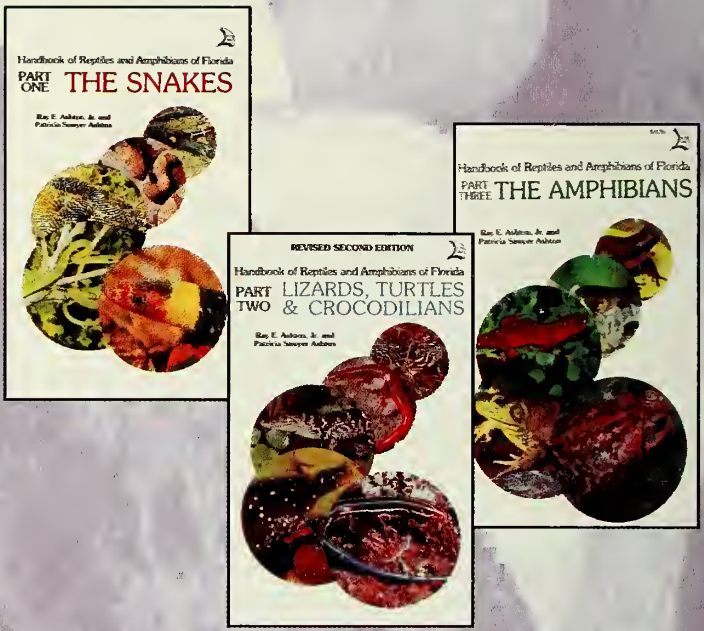

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