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A first checklist of native names and ethnozoological notes of snakes (Squamata: Serpentes) from Kichwa and Shiwiar territories at the Amazonian Ecuador

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ABSTRACT

Traditional knowledge, much like scientific knowledge, is the product of observation and reflection from the relationship between people and their habitat. This paper documents the first inventory of native names and ethnozoological information of snakes in the language of the Shiwiar-Chicham (SC) and Kichwa (KW), for those territories located in the Pastaza and Napo basins, Amazonia of Ecuador. Additionally, we analyzed the diversity of native names with the Shannon-Wiener index (D). A total of 50 snake species are inventoried, where 36 species (80%) and 49 (100%) snakes possessed a name in the SC and KW languages, respectively. The KW language (D = 4.02) presented a greater diversity of names assigned to snakes, in comparison to the SC language (D = 3.04). The great cultural and linguistic diversity demonstrates that there is still a need to document and safeguard the ethnozoological knowledge related to snakes in the Amazon.

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Ethnoherpetology; nomenclature; taxonomy; linguistic heritage; conservation

Introduction

The Indigenous peoples and nationalities of the Amazon region have developed diverse systems of knowledge, drawing from different facets of the rainforest [1–4]. The rich bio-cultural knowledge of the Indigenous people, which includes their genetic, linguistics, cognitive, and agricultural practices, has been influenced by the constant dialogue between the peoples and their surroundings throughout hundreds of years [5,6].

Globally, the importance of traditional knowledge and its techniques complementing scientific knowledge in areas such as environmental impact assessment, resource management, and sustainable development [3,7]. Ethnobiological studies reveals that local populations have a profound knowledge of nature and biological resources [7,8], but still reflect little on their theoretical contributions [9]. The inclusion of traditional ecological knowledge about biodiversity in decision making, in conjunction with scientific knowledge, result fundamental for the conservation of natural resources [10,11].

Ecuador is located in the equatorial tropical Andes in South America, ranking among the 17 most biologically and culturally diverse and rich countries on the planet [12,13]. In this plurinational, pluricultural, and multi-ethnic country, the recognition and integration of traditional and local knowledge systems are fundamental [1,14–16]. From an ethnic standpoint, 13 nationalities and 14 Ecuadorian indigenous groups contribute to Ecuador's linguistic, ethnic, and understanding of eco-diversity, through the narration of their traditions, customs, and ways of life [15,16]. Much of this ethnological diversity is located in the Amazon region of Ecuador, where almost all the native languages are derived from the most important linguistic families (i.e. Quechua), in South America [17–19]. These knowledge systems are dynamic forms of perception, expression, and understanding of the world that have contributed to science and technology throughout history. As such, these systems must be protected, investigated, and promoted as a cultural heritage and knowledge [20], because several languages are considered as endangered [21]. Thus, Ecuador is part of one of the most highest linguistic diversity areas in the world, from the genealogical point of view [8,22].

The Kichwa nation is the largest in the Amazon and Ecuador where their language is spoken in most eastern provinces [23]. In the last 500 years, Kichwa has been the fastest-growing American-Indian language, with an estimated > 8 million speakers, and has become the most widespread indigenous language [18]. The Achuar dialect is spoken in the border areas with Peru of the provinces of Morona Santiago and Pastaza in Ecuador. It should be noted that within the Shuar dialect

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there are several subdialects in Amazonia, among them the southern speech (Bomboiza, Zamora, etc.) and the northern one (Sucua, Chiguaza, etc.). There is also another subdialect, in the province of Pastaza known as Shiwiar, spoken by several communities along the Pastaza Basin [24].

Herpetology, from the Greek *herpeton* to crawl, refers to the study of amphibians and reptiles. Snakes are reptiles belonging to the group of *Ophidia* or *Serpentes* and are characterized by a limbless, scaly and elongated body. Relative to its landmass, Ecuador has the greatest diversity of reptiles with 459 species; 237 correspond to snakes, 46 of which are endemic <unique> to Ecuador, representing 6% of the world's diversity [25]. From an anthropological perspective, snakes have been particularly studied and linked to diverse cultures worldwide, including studies in the Amazon [16,26,27].

The symbolic relationship between humans and snakes is undoubtedly millenary and is present in all cultures, as evidenced by the vast range of artifacts found in archaeological sites around the world [28,29]. Biological inventories and ethnozoological documentation are fundamental to understanding the relationship between cultures and the natural environment, through the joint development of sustainable management and conservation strategies [30]. There exists a wide range of ethnozoological research in the Neotropics, being Mesoamerica a referenced region for anthropological, ethnological, and ecological studies [3,7,31]. In the context of Ecuador, the perception of the ophidians among the Amazonian peoples is framed in a dichotomous relationship between the sacred, in which snakes are respected deities and linked to the shamanic power, and the dark or malignant [1,16]. The latter of which may have developed from the influence of Christianity and the relationship of snakes with the original sin or the fatal nature of the bites of some species [32].

This research aims to document the first checklist of local names in the Kichwa and Shiwiar-Chicham languages and ethnozoological notes of snakes registered in the Upper Napo and Pastaza River Basins, Amazonia of Ecuador.

Methods

Study area

The current study consisted of focal group interviews in three Shiwiar localities of the Pastaza river basin, five Kichwa localities of the upper Napo river basin, and one Kichwa-speaking locality in the Zápara territory of the Pastaza river basin (Figure 1). Those territories correspond mainly to Lowland Evergreen Forests from Napo, Curaray, Pastaza and Tigre basins [33]. Shiwiar territories includes Kurintza (2,060 ° S 76,780), Juyuintza (2,110 ° S 76,190 ° W), and Bufeo (2,190 ° S 76,790 ° W) communities in the Pastaza province. In the Napo province, Kichwa territories includes the Centro Parroquial de Ahuano (1.050908° S, 77.549297° W), Atacapi (0.956437° S, 77.859635° W), Comunidad Kichwa 21 km road from Tena to Quito (0.7988715° S, 77.7803591° W), El Calvario (0.972026° S, 77.879908° W), and Shitu Runa community (0.9024 ° S, 77.3127 ° W) in the Chonta Punta parish. In the Sápara territory, we study the community of Pindoyaku (1,730 ° S 76,610 ° W), province of Pastaza, (Figure 1).

Documentation of native names

Interviews to document the local names of snakes in native languages were conducted in Spanish, Shiwiar, and Kichwa. Photographic plates [34], referenced specimens from scientific collections from the Instituto Nacional de Biodiversidad (INABIO/https://bndb.sisbioecuador.bio/bndb/index.php), photographic catalogue from BIOWEB (Museo de Zoología de la Universidad Católica del Ecuador [QCAZ/ [35]]. A Tascam Dr-07 mkII recorder and EEG's Lexi Pro version (documentation program) were used to record ethnozoological information. Interviews with the Shiwiar peoples took place during community meetings and included 18 individuals between 25–30 years of age and two older adults (60 years old) from the Kurintza, Juyuintza, and Bufeo communities. A total of 29 Kichwa people between 37 to 94-year-old, were interviewed from Centro Parroquial de Ahuano, Atacapi, Comunidad Kichwa 21 km road from Tena to Quito, El Calvario, and three people over the age of 60 and 53-year-old, who acted as a translator, from the Shitu Runa community in the Chonta Punta parish. In the Sápara territory, an individual of 53 years was interviewed, a Kichwa-speaker, from the community of Pindoyaku. Taxonomic verification of Ecuadorian species follows to Torres-Carvajal, Pazmiño-Otamendi [25].

Diversity of local names

Following the principles of entropy to assess the importance of species in ecological communities [36], the diversity of names assigned to snakes was analyzed using the Shannon-Wiener index (D). This index was calculated based on the frequencies of species associated with local names in Shiwiar-Chicham and Kichwa languages, in different combinations. $D = \sum_{i=1}^{S} = p_i \ln p_i$; where, S refers to the number of

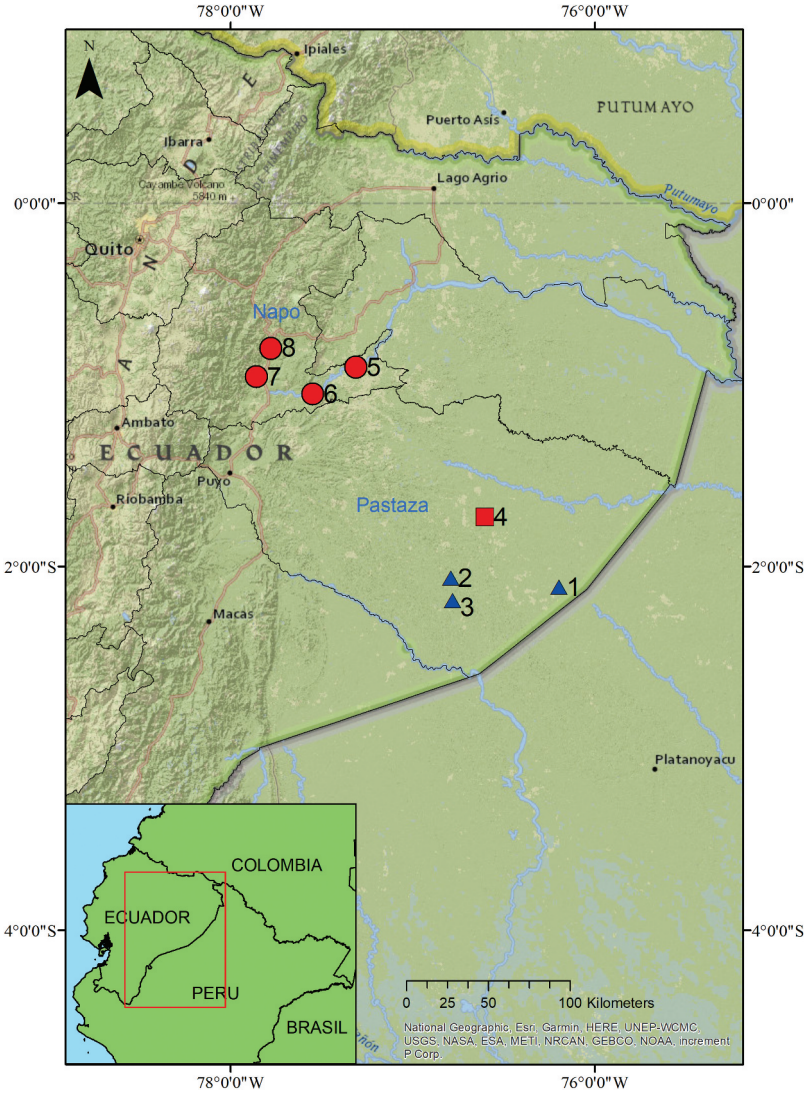

Figure 1. Sites of study in Shiwiar localities (blue), a locality a Kichwa-speaking locality in Sápara territory of the Pastaza River Basin (white), and a locality in Kichwa territory in the Napo River basin (red), Ecuador. 1. Juyuintza 2. Kurintza 3. Bufeo 4. Pindoyaku 5. Chonta Punta 6. Centro Parroquial de Ahuano, 7. Atacapi and El Calvario 8. Comunidad Kichwa 21 km road from Tena to Quito.

identified linguistic names, p the proportion of the species of snake, i refers to the total number of snakes in the inventory or the relative abundance of the name (n_iN). It does not refer to the number of snake species associated with i, and N representing the total number of snakes. The error bars of the D index were calculated with a sampling of 10,000 bootstraps in the PAST program [37]. Relations between taxonomic names per family to local names in Kichwa and Shiwiar Chicham languages were drafted with NetworkD3 and Tidyverse packages in R software.

Notes on ethnozoology

In addition to the documentation of names in native languages, local communities from Napo province were consulted on knowledge of morphology, habitat, behaviour, and the myths and beliefs associated with snakes.

Results

Checklist

A total of 50 species of snakes (Squamata: Serpentes) from five families are registered at Shiwiar (45 spp) and Kichwa (49 spp) localities. From them, Colubridae was the richest-most family with 33 spp, followed by Viperidae (8 spp), Boidae (5 spp), Elapidae (3 spp), and Aniliidae with one species (Table 1; Supplementary Table S1).

Diversity of names in Kichwa and Shiwiar-Chichem languages

A total of 49 (100%) snake species were found to have a name in Kichwa, while 36 species (80%) had a name in the Shiwiar-Chicham language (Figure 2, Tables 1–2, Supplementary Table S1). A total of 66 and 21 unique names in the Kichwa and Shiwiar-Chicham languages were registered to identify local snakes, respectively

Table 1. Snake species documented at Kichwa and Shiwiar Territories in Napo and Pastaza provinces, Ecuador, and associated voucher specimens. Photo voucher number from Ortega-Andrade [34]*.

N°	Family, species	Voucher	Kichwa	Shiwiar
	Aniliidae			
1	*Anilius scytale* *	Photo voucher 211	X	X
	Boidae			
2	*Boa constrictor* *	Photo voucher 212	X	X
3	*Corallus batesii* *	Photo voucher 213	X	X
4	*Corallus hortulana* *	Photo voucher 214	X	X
5	*Epicrates cenchria* *	Photo voucher 216	X	X
6	*Eunectes murinus* *	Photo voucher 218	X	X
	Colubridae			
7	*Atractus major* *	Photo voucher 220/DHMECN 4450	X	X
8	*Atractus occipitoalbus* *	Photo voucher 221	X	X
9	*Chironius exoletus* *	Photo voucher 224	X	X
10	*Chironius fuscus* *	Photo voucher 225	X	X
11	*Chironius monticola*	KU146733/QCAZR12597	X	
12	*Chironius multiventris* *	QCAZR8192	X	X
13	*Chironius scurrulus*	JAPGOV8461/AMNH49065	X	X
14	*Clelia clelia* *	Photo voucher 227	X	X
15	*Dendrophidion dendrophis*	QCAZR4978	X	X
16	*Dipsas catesbyi* *	Photo voucher 228	X	X
17	*Dipsas indica ecuadoriensis* *	Photo voucher 229	X	X
18	*Dipsas pavonina*	QCAZR2818	X	
19	*Drepanoides anomalus* *	Photo voucher 230	X	X
20	*Drymobius rhombifer* *	Photo voucher 232	X	X
21	*Drymoluber dichrous* *	Photo voucher 235	X	X
22	*Helicops angulatus* *	Photo voucher 237	X	X
23	*Imantodes cenchoa* *	Photo voucher 238	X	X
24	*Imantodes lentiferus* *	Photo voucher 240/DHMECN 4368	X	X
25	*Leptodeira annulata* *	Photo voucher 241	X	X
26	*Leptophis ahaetulla nigromarginatus* *	Photo voucher 242	X	X
27	*Leptophis aff. riveti* *	Photo voucher 243/DHMECN 4760	X	X
28	*Oxybelis aeneus* *	Photo voucher 244	X	X
29	*Oxyrhopus formosus* *	Photo voucher 245	X	X
30	*Oxyrhopus melanogenys* *	Photo voucher 246	X	X
31	*Oxyrhopus petolarius* *	Photo voucher 247	X	X
32	*Rhinobothryum lentiginosum* *	Photo voucher 249	X	X
33	*Siphlophis compressus* *	Photo voucher 250	X	X
34	*Spilotes sulphureus* *	Photo voucher 248	X	X
35	*Taeniophallus brevirostris* *	Photo voucher 251		X
36	*Xenodon rabdocephalus* *	Photo voucher 252/DHMECN 4456	X	X
37	*Xenodon severus*	QCAZR8043	X	
38	*Xenopholis scalaris*	QCAZR11758	X	X
39	*Xenoxybelis argenteus* *	Photo voucher 253/QCAZR4991	X	X
	Elapidae			
40	*Micrurus helleri* *	Photo voucher 254/DHMECN 4447	X	X
41	*Micrurus narduccii*	QCAZR7622	X	X
42	*Micrurus surinamensis*	QCAZR8936	X	X
	Viperidae			
43	*Bothrocophias hyoprora* *	Photo voucher 257	X	X
44	*Bothrocophias microphthalmus*	QCAZR6203	X	
45	*Bothrops atrox* *	Photo voucher 258/DHMECN 4761	X	X
46	*Bothrops bilineata smaragdina**	Photo voucher 255	X	X
47	*Bothrops brazili* *	Photo voucher 259	X	X
48	*Bothrops pulcher*	QCAZR11068	X	X
49	*Bothrops taeniata* *	Photo voucher 256/DHMECN 4455	X	
50	*Lachesis muta* *	Photo voucher 260	X	X

(Table 1). The Kichwa language (D = 4.02, CI = 3.99–4.17) presented a greater diversity of names assigned to snakes, compared to the Shiwiar language (D = 3.04, CI = 2.66–3.15). In the case of the Kichwa language, 15 (31%) snake species are recognized with one single name, 30 species range from two to fine names (61%) and four species (8%) from Colubridae, Viperidae and Boidae have at least six names and their variants (Figures 3–4, Table 3, Supplementary Table S1). In the Shiwiar language, only *Eunectes murinus* (Boidae, Anaconda) is recognized by two names (Tuntú panki/ Kuchánmaya pánki), while the 37 remaining species have a single assigned name (Figures 3–4, Table 4, Supplementary Table S1).

Notes on ethnozoology

The checklist of local names for snakes from Kichwa localities reveals that *Bothrops bilineata* (Viperidae), *Chironius exoletus* (Colubridae), *Drymoluber dichrous* (Colubridae) and *Eunectes murinus* (Boidae) have the most diverse number of names assigned, with six different each (Figure 3, Supplementary Table S1). Twenty-one (42%) names were related to shape and color (Supplementary Table S1). For example, "Sinta machakui" refers to a ribbon of intercalated colors that is common to snakes of the genera *Drymobius, Imantodes, Oxybelis, Oxyrhopus* and *Xenoxybelis*; the names "muriti machakui" and "manduru machakui"

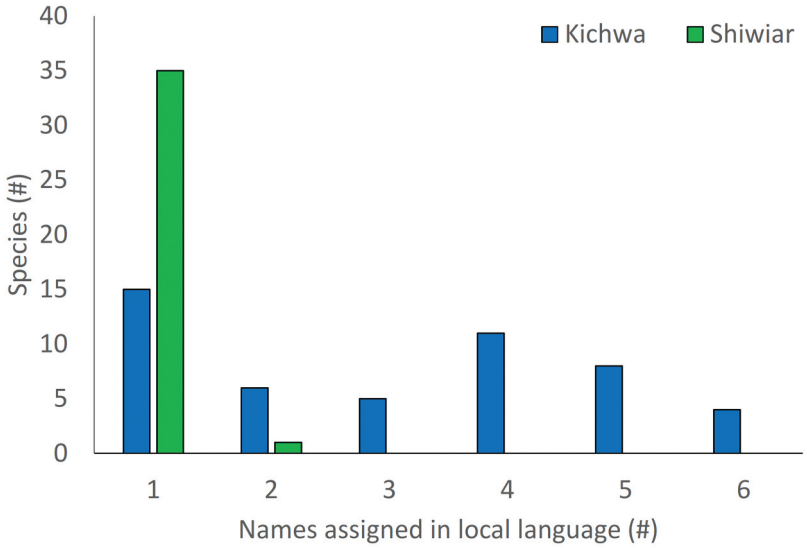

Figure 2. Distribution of snakes species related to the names assigend by Kichwa and Shiwiar languages. *Bothrops bilineata* (Viperidae) is represented in background, taken by H. Mauricio Ortega-Andrade.

Table 2. Characterization of the registered nomenclature for the list of snake species in the Kichwa and Shiwiar native languages. The Shannon-Wiener index is represented with an error calculated through a sampling of 10,000 bootstraps.

Characteristics of nomenclature	Kichwa	Shiwiar
Number of species	49	45
Snakes with assigned names	49	36
Unique names per language	66	21
Percentage of species with names in the native language	100%	80%
Shannon-Wienner Diversity (D) (Lower-Upper 95%)	4.02 (3.99–4.17)	3.04 (2.66–3.15)
Total number of snakes in the inventory	50 species	

refer to reddish coloration, similar to the Morete (Arecaceae: *Mauritia flexuosa*) or achiote (Bixaceae: *Bixa orellana*) fruits, of the genera *Drepanoides, Oxyrhopus, Rhinobothryum* and *Micrurus*. Twenty-four (48%) names are related to the habits and life forms of snakes. For example, "wakra machakui" refers to snakes that are often observed in sunny areas where cows (wakra in Kichwa) live and are related to the species *Clelia clelia, Drymoluber dichrous*, and *Liophis riveti*. The names "Yaku pitalala"/"Waska Pitalala machakui" refer to the aquatic habit of *Helicops angulatus* (Figure 3, Table 3, Supplementary Table S1). Five species are identified as arboreal (*Boa constrictor, Corallus batesii, Corallus hortulanus, Epicrates cenchria* and *Bothrops bilineata*)

People perceived 11 species (22%) to display aggressive behavior and 14 species (28%) are being docile. Species of the genera *Anilius, Corallus, Eunectes, Drepanoides, Leptophis, Bothrops* and *Lachesis* are among the species that are perceived as being aggressive. From these, the last three genera correspond to the venomous family Viperidae (Table 1). Interestingly, species of *Micrurus* (Elapidae) are not considered as aggressive or venomous.

A total of 18 species (36%) are considered symbolic or play a role in indigenous belief systems. For example, *Drepanoides anomalus, Clelia clelia* and *Drymoluber dichrous* are thought to "punish lying people with their tails". Four species (*Oxyrhopus petola digitalis, Leptophis ahaetulla, Imantodes cenchoa, Oxyrhopus formosus*) are associated with Shamans, bad omens, and the death of relatives. The snakes of the genus *Bothrops*, and Lachesis are related as venomous snakes that cause death, but other non-venomous Boids species, like *Corallus batesii* and *Corallus hortulanus*, are also considered as venomous. Kichwa people perceive that the bite of *Helicops angulatus*, an aquatic snake, protects them from venomous vipers. The fat and flesh of *Xenodon rabdocephalus rabdocephalus* and *Boa constrictor* has been used as medicine. A very particular perception which is shared by both Shiwiar ("Yámunk") and Kichwa people ("Mutulu"/"Sara Machakui"), is the belief that *Lachesis muta* sings from the trunks of the trees in acoustic sequences "corocorocorocorocococo", but it is confused by the limbed hylid frog *Tepuihyla tuberculosa* [38; Figure 3]

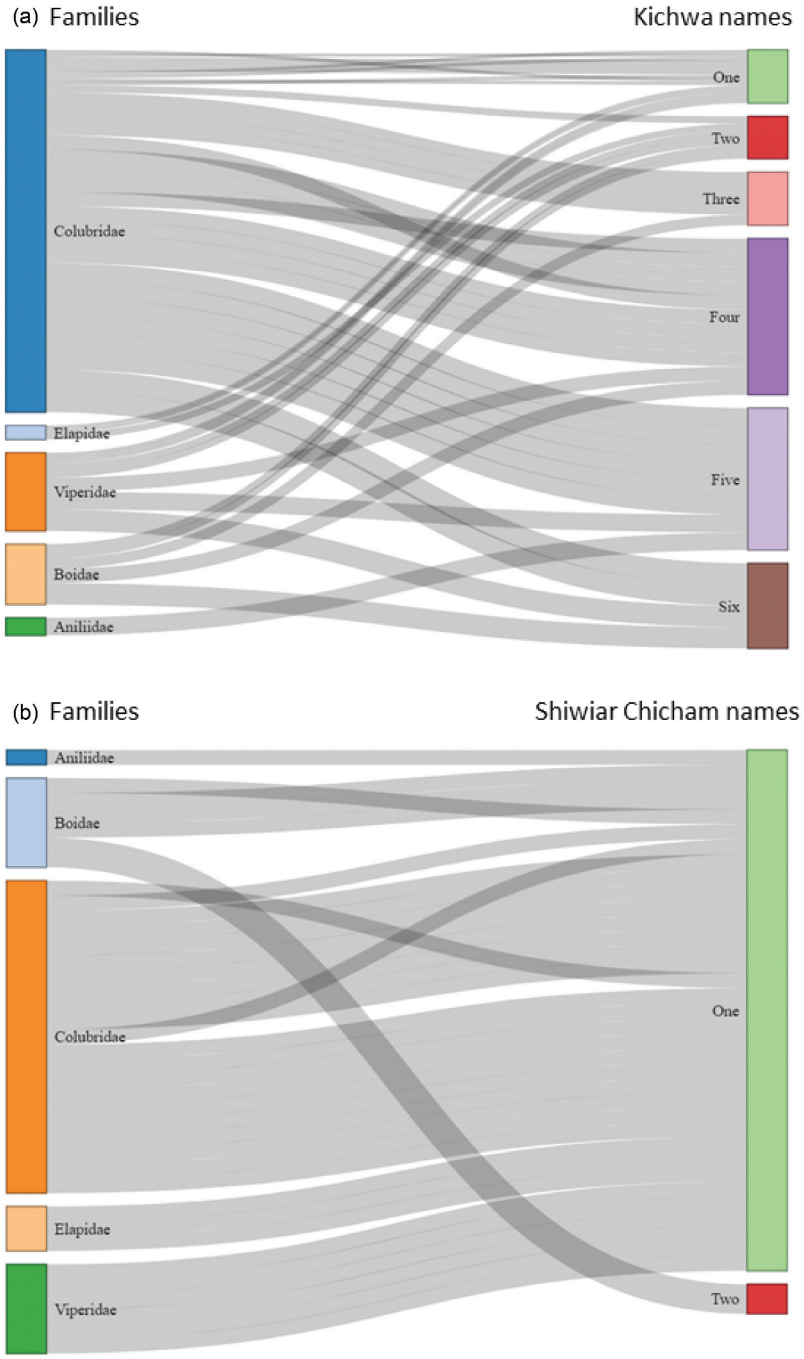

Figure 3. Relationships between snake species by family documented for Kichwa (a) and Shiwiar-Chicham (b) languages. Note that the diversity of names, up to six variants, is greater for the Kichwa language (a), compared to those registered for the Shiwiar language (b).

Discussion

This paper documents the first checklist of local names in the Kichwa and Shiwiar-Chicham languages, and provides ethnozoology notes of snakes from Kichwa people located in nearby areas at Tena region in the upper part of the Napo Basin, whereas Shiwiar names are mostly related to people from the lower Pastaza Basin, Amazonia of Ecuador. Fifty species of snakes are documented herein, corresponding to 20% of the total number of known Ecuadorian species, but the 70% of tropical lowland Amazonian species [38].

According to Shannon-Weiner indices, greater diversity on local names is reported in the Kichwa-speaking localities, compared to those registered in the Shiwiar localities (Table 2). The sociolinguistic ecology in the Kichwa language is more complex and constantly shifted with a wide variation in local names, compared to the Shiwiar-Chicham language (Figures 2 and 3, Table 2), may be considered as a product of their unique customs, narratives, and cultural structure [19]. Another explanation for this difference regards the widespread adoption of the Kichwa language, compared to the Shiwiar-Chicham,

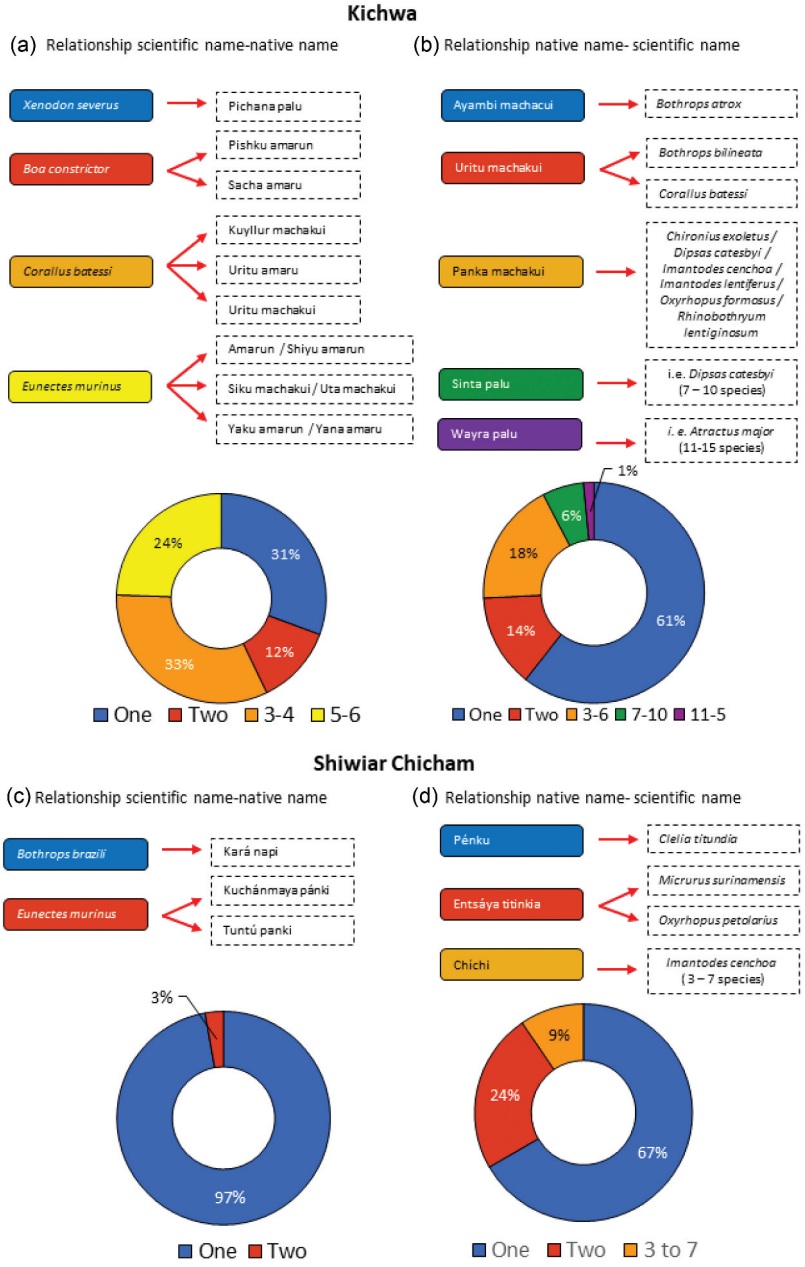

Figure 4. Relationships between scientific and native names in snakes documented for Kichwa (A-B) and Shiwiar-Chicham (c-d) languages. Note that the diversity of names is greater for the Kichwa language (a-b), compared to those registered for the Shiwiar language (c-d).

by people located along the Andes, the Amazon foothills, and lowlands that could have contributed to its diversification by geographic differentiation [22]. Several dialects of Kichwa are also spoken in the region Amazon region, mainly by the unions between people of different peoples and nationalities, and by the mixture with Spanish words [24]. Data analysed herein give us the first outlook to infer and test those hypotheses for future regional ethnozoological studies.

Contributions on the knowledge of snake ethnozoology from Amazonian Ecuador

The local imagination regarding snakes is enriched by a series of concepts, perceptions, myths, and legends [3,7,16,26], such as in stories where snakes are endowed with human characteristics, as a means of understanding their behaviour, or in which humans are transformed into snakes as a means of better explaining human nature [16,19,28,39]. Other tales involve snakes which are represented as superhuman, magical, or transcendental beings associated with the underworld, the earth, and as beings representing the divinity of the new moon [29]. This way of thinking, described by Descola [14] as "animism", is the ability of the Amazonian inhabitants to view nature and humans as a single, inseparable entity. The most important goodness in their imagination is the "Amarun" (*Eunectes murinus*, "Anaconda") and the myths associated with flooding rivers, the increase of fish populations, the

Table 3. Names in Kichwa native language and the frequency of snake species associated with each taxonomic family. The combined variants occur when a species of snake is recognized by two or more names in the native language.

	Families					
Native names	Aniliidae	Boidae	Colubridae	Elapidae	Viperidae	Total
Ahua Pitalala Machakui					1	1
Allpa machakui			2			2
Allpa manduru machakui	1		1			2
Allpa Pitalala			1			1
Amarun		1				1
Ankas Panka Machakui			1			1
Ayambi Machacui					1	1
Chunta Palu			1			1
Equis Pitalala			1			1
Hatun Uritu Machakui			1			1
Ichilla Uritu Machakui					1	1
Killupanka machakui			1			1
Kindi Machakui			1			1
Kuyllur Machakui		1				1
Kuyllur Pitalala			1		1	2
Manduru Machakui			7	1		8
Manduru Palu	1		3	3		7
Manku Shishi					1	1
Muriti Amarun	1	1	1			3
Muriti Machakui	1		2			3
Mutulu					1	1
Mutulu machakui			2			2
Panka Machakui			6			6
Pichana palu			1			1
Pishku Amarun		2			1	3
Pishku Machakui			1			1
Pitalala			1		3	4
Pitalala Machakui			1			1
Puka ukumbi machakui		1				1
Puka wakra machakui			1			1
Pukushka Machakui	1		2			3
Pushliu					2	2
Rupai Machakui			2			2
Sacha Amaru		1				1
Sapu machakui			3			3
Sara machakui			2		2	4
Shigra machakui			1			1
Shikly machakui			1			1
Shinshi			1		1	2
Shinshi Machakui					1	1
Shiwa Palu					1	1
Shiyu Amarun		1				1
Siku machakui		1	3			4
Sinta Machakui			9			9
Sinta Palu			8			8
Tapia amarum			1			1
Tulan machakui			1			1
Ukumbi		1				1
Ukumbi machakui		1				1
Uritu Amaru		1				1
Uritu machakui		1			1	2
Uritu Palu					1	1
Ushkulin					2	2
Ushpa Pitalala					1	1
Ushpa Ukumbi machakui		1				1
Uta machakui		1				1
Wakra machakui			6			6
Wamburip Wakra Machakui			1			1
Waska Machakui			3			3
Waska Pitalala			3			3
Waska Pitalala Machakui			1			1
Wayra Palu			15			15
Yaku amarun		1				1
Yaku Pitalala			1			1
Yana Amaru		1				1
Yana Wakra Machakui			1			1
Unique native names (combined variants)	5(5)	16(17)	41(102)	2(4)	17(22)	66(150)
Snake's species with native names	1	5	32	3	8	49
% of species with native names	100	100	100	100	100	100
Total species	1	5	32	3	8	49

Table 4. Names in the Shiwiar native language and the frequency of snake species associated with each taxonomic family. The combined variants occur when a species of snake is recognized by two or more names in the native language.

	Families					
Native names	Aniliidae	Boidae	Colubridae	Elapidae	Viperidae	Total
Chíchi			7			7
Entsáya titinkia			1	1		2
Ipiák tintinkia			2			2
Kará napi					1	1
Kawáikiam		1			1	2
Kuchánmaya pánki		1				1
Makánch			1		1	2
Namákrunch			1			1
Nemaránch napi					1	1
Nunkáya titinkia	1					1
Nunkuí			1			1
Pánki		1				1
Pénku			1			1
Shuwín titinkia			1			1
Titinkiá				2		2
Tuntú panki		1				1
Wápu		1				1
Wayás			6			6
Yakúm panki		1				1
Yámunk					1	1
Yawá yawa					1	1
Unique native names (combined variants)	1(1)	6(6)	9(21)	2(3)	6(6)	21(37)
Snake's species with native names	1	5	21	1	6	36
% of species with native names	100	100	70	33	100	80
Total species	1	5	30	3	6	45

birth of children, and the main source of life and fertility [39]. As Whitten [40] describe it, "the majority, if not the totality, of Andean and Amazonian people conceive the Anaconda as a source of maximum internal power -chthonic power-, that is, the collective and individual inner power".

The presence of snakes in the social, spiritual, symbolic life of the Amazonian inhabitants manifests itself in the relationships that the peoples have established with these animals based on their detailed observation, interpretations of life, dreams, and medicine [1,26,28]. Herein, we reported a first checklist on the local knowledge regarding the behaviour, myths, and habits (Supplementary Table S1). In the case of *Drymobius rhombifer*, it has been described as timid enough that "children play with it, carry it in their pockets" but has been known to "bite(s) if they bother you". The warning and defensive behaviour of *Bothrops taeniata* were also known to the individuals interviewed in this study, in that "when it does not want to bite, it hits the floor with its tail". Other observations and folk knowledge stemming from said observations include: "sing like a toad to call each other"(e.g. *Lachesis muta*, confused with the frog *Tepuihyla tuberculosa* [41], "chase people to make them scare" (e.g. *Drepanoides anomalus*), "Crazy, makes jump, makes frighten, makes the most vague" (e.g. *Pseustes sulphureus*).

The intent attributed to the behaviour of snakes can be understood from the perspective of the indigenous cosmologies of the Amazon, which do not classify beings into the domains of men, animals, and plants [1]. This domain-agnostic view of the world is essential to the understanding of these cosmologies as understood by different peoples and nationalities. In the case of the Achuar people -a close relative to Shiwiar people-, most animals and plants are believed to have a soul or "wakan" similar to that of human beings which gives them self-awareness and intent [14].

Based on the anecdotal evidence gathered in the current study, the snake *Lachesis muta* (Viperidae), known as "Yamung" in the Shiwiar language, or "Mutulu"/"Sara Machakui" in the Kichwa language, is identified as a species "(. . .) that sings like a toad 'corcorcorcorcorcor' to be called one another, or they ask each other. Where will another partner be? (. . .)". In this account, an intention (the desire to find a mate) is identified which is attributed to the snake's particular call, according to local testimonies. In this light, the snake is personified; blurring the boundaries between what we consider the domains of man and animal [14]. However, a recent investigation concluded that the call associated by the "warty" *-Lachesis muta-* by the Indigenous peoples of the Amazon in Peru and Ecuador, is produced by two different Hylid tree frogs, *Tepuihyla shushupe* from Peru, and *T. tuberculosa* from Ecuador (Ron et al. 2016; Figure 5).

Snakes bear symbolic importance in the Kichwa and Shiwiar cultures. In the collective imagination of both groups, the importance of snakes has spawned myths, stories, and legends that transcend the contemporary fear associated with ophidians (Figure 6). We documented that snakes are present in the daily life of the communities, in the form of children's games, natural medicine, dreams, the forest, roads, and on the banks of rivers; all of which highlight the importance of these

Figure 5. A particular belief which is shared by both Shiwiar ("Yámunk") and in Kichwa ("Mutulu"/"Sara Machakui") cultures, is related with sings by the "masterbush" *Lachesis muta* (A) which is confused with the call of the limbed tree frog *Tepuihyla tuberculosa* (B). The later species has been recorded calling from flooded tree holes in several localities in Ecuador and Peru [41]. Photographs: Specimens from Juyuintza, Pastaza Basin, taken by H. Mauricio Ortega-Andrade.

Figure 6. Artistic depiction of a story about an Anaconda (*Eunectes murinus*) in the Napo River basin. Author: Mishque Cuyumbo, Tena, Ecuador.

creatures in the cultural construct of indigenous peoples and nationalities in the Amazon. In this regard, it is of great interest to continue developing an ethnozoological inventory of snake species that relates their names in the original language and the cultural knowledge that surrounds them, as the first step in understanding and appreciating the worldview and knowledge of indigenous nationalities regarding the Amazonian ophidian fauna. In doing so, we step forward to guarantee future work in the conservation and management of biodiversity, through interdisciplinary research projects that work hand-in-hand with local experts on issues related to biological and cultural heritage [5,20].

The great cultural and linguistic diversity identified herein demonstrates a vast need to document and safeguard the ethnozoological knowledge

related to snakes in the Amazon. We hope that this work will serve as the starting point for further investigation on the ethnobiology of Ecuadorian herpetofauna.

Dreaming snakes

My wife comes in and asks me, "What are you doing?", and I respond, "I'm killing a boa, but it's already broken". Then, I do not know...I feel sad, and I ask "Why did I cut the boa's head off? Why did you cut the tail?". In the dream, I pondered this point and when I woke, I was still thinking about this. My wife was next to me, and she asked me, "What did you dream of?" I told her and she did not answer. I told her that something was going to happen, someone was going to die. That morning I spoke for a while and left for work. As I was going out, grabbing the machete, I heard a voice shouting at me from behind "Come pal, come, a person has died ... (José Shiguango, recounting a dream with snakes – Tena, Napo, 20 September 2016).

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References

[1] Descola P. Las cosmologias indígenas de la Amazonia. In: Surrallés A Hierro P, editors Tierra adentro: territorio indígena y percepción del entorno. Lima, Perú: Tarea Gráfica Educativa; 2004. p. 25–36.
[2] Alves RRN, Souto WMS, Albuquerque UP. Ethnozoology: conceptual and historical aspects. In: Nóbrega Alves R, editor. Ethnozoology: animals in Our Lives. Elsevier; 2018. p. 9–24. doi: 10.1016/B978-0-12-809913-1.00002-8
[3] Santoro FR, Nascimento ALB, Soldati GT, et al. Evolutionary ethnobiology and cultural evolution: opportunities for research and dialog. J Ethnobiol Ethnomed. 2018;14(1):1. doi: 10.1186/s13002-017-0199-y
[4] Fernández-Llamazares Á, Lepofsky D. Ethnobiology through song. Journal Of Ethnobiology. 2019;39 (3):337–353. doi: 10.2993/0278-0771-39.3.337
[5] Graddy TG. Regarding biocultural heritage: in situ political ecology of agricultural biodiversity in the Peruvian Andes. Agriculture And Human Values. 2013;30(4):587–604. doi: 10.1007/s10460-013-9428-8
[6] Agnoletti M, Rotherham ID. Landscape and biocultural diversity. Biodivers Conserv. 2015;24(13):3155–3165. doi: 10.1007/s10531-015-1003-8
[7] Alves RRN. Relationships between fauna and people and the role of ethnozoology in animal conservation. Ethnobio Conserv. 2012;1(2012):1–69. doi: 10.15451/ec2012-8-1.2-1-69
[8] Dahl Ö, Gillam JC, Anderson DG, et al. Linguistic diversity zones and cartographic modeling: gIS as a method for understanding the prehistory of lowland South America. In: Hornborg A, and Hill J, editors. Ethnicity in Ancient Amazonia : reconstructing past identities form archaeology, linguistics, and ethnohistory. United States of America: University Press of Colorado; 2011. p. 210–224.
[9] Ferreira Júnior WS. Reflections on the theoretical advance in ethnobiology: are we pointing to the wrong direction? Ethnobiology And Conservation. 2020;9(20):1–8.
[10] Martin JF, Roy ED, Diemont SA, et al. Traditional Ecological Knowledge (TEK): Ideas, inspiration, and designs for ecological engineering. Ecol Eng. 2010;36 (7):839–849. doi: 10.1016/j.ecoleng.2010.04.001

[11] Niesenbaum RA. The integration of conservation, biodiversity, and sustainability. Sustainability. 2019;11 (17):4676. doi: 10.3390/su11174676
[12] Josse C. La biodiversidad del Ecuador. Informe 2000. Quito: Ministerio del Medio Ambiente, EcoCiencia y UICN; 2001.
[13] UNEP-WCMC. Conservation dashboard for Ecuador United Kingdom: The United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) 2014. Available from: https://www.unep-wcmc.org/#?country=EC&dashboard=show
[14] Descola P. La selva culta: simbolismo y praxis en la ecología de los Achuar. Vol. 3. Quito, Ecuador: Editorial Abya Yala; 1996.
[15] Ruiz L. La diversidad biológica y cultural en la Amazonía ecuatoriana. In: Mena P, and Suárez L, editors La investigación para la conservación de la diversidad biológica en el Ecuador. Quito, Ecuador: Fundación Ecociencia; 1993. p. 129–147.
[16] Valarezo SJA. La selva, los pueblos, su historia: mitos, leyendas, tradiciones y fauna de la Amazonía ecuatoriana. Quito, Ecuador: Abya; 2002.
[17] Haboud M, Ostler N. Endangered Languages: voices and Images (FEL XV): voces E Imagenes de Las Lenguas en Peligro (PUCE I). Quito, Ecuador: Foundation for Endangered Languages, Pontificia Universidad Católica del Ecuador; 2011.
[18] Hudelson JE. La cultura Quichua de transición: Su expansión y desarrollo en el Alto Amazonas. Quito, Ecuador: Ediciones Abya Yala; 1987.
[19] Wroblewski M. Amazonian Kichwa Proper: Ethnolinguistic domain in Pan-Indian ecuador. Journal Of Linguistic Anthropology. 2012;22(1):64–86. doi: 10.1111/j.1548-1395.2012.01134.x
[20] Brozek JM. Declaration on science and the use of scientific knowledge. Eur Psychol. 2000;5(1):66–71.
[21] Moore D. Endangered languages of lowland tropical South America. In: Bisang W, Hock H, Winter W, editors. Language diversity endangered. Berlin: Mouton de Gruyter; 2007. p. 29–58. doi: 10.1515/9783110197129.29.
[22] González-Andrade F, Sánchez-Q D, Martínez-Jarreta B. Genetic analysis of the Amerindian Kichwas and Afroamerican descendents populations from Ecuador characterised by 15 STR-PCR polymorphisms. Forensic Sci Int. 2006;160(2–3):231–235. doi: 10.1016/j.forsciint.2005.08.002
[23] Knapp G. The changing kichwa language map in ecuador. Handbook Of The Changing World Language Map. 2018;1:1–12.
[24] Álvarez C. Estado de la lenguas en las nacionalidades de la Amazonía ecuatoriana. Ecuador: UNICEF, Universidad de Cuenca; 2007.
[25] Torres-Carvajal O, Pazmiño-Otamendi G, Ayala-Varela F, et al. Reptiles del Ecuador. Version 2020.1. Quito, Ecuador: Museo de Zoología, Pontificia Universidad Católica del Ecuador; 2021. Available from: https://bioweb.bio/faunaweb/reptiliaweb
[26] Alves R, Santana G, Almeida W, et al. Reptiles used for medicinal and magic religious purposes in Brazil. Appl Herpetol. 2009;6(3):257–274. doi: 10.1163/157075409X432913
[27] Zug GR, Vitt LJ, Caldwell JP. Herpetology: an introductory biology of amphibians and reptiles. San Diego, California: Elsevier Science, Academic Press; 2001.
[28] Mundkur B. The roots of ophidian symbolism. Ethos. 1978;6(3):125–158. doi: 10.1525/eth.1978.6.3.02a00010
[29] Valencia J, Garzón-Tello K, Barragán-Paladines ME. Serpientes Venenosas del Ecuador. Quito, Ecuador: Fundación Herpetológica Gustavo Orcés; 2016.
[30] Toledo VM. La Red de Etnoecología y Patrimonio Bioculturaldel Consejo Nacional de Ciencia yTecnología, México. Etnoecológica. 2012;9(1):82–84.
[31] Alves RRN, Souto WMS, Albuquerque UP. Chapter 2 - Ethnozoology: conceptual and historical aspects*. Nóbrega Alves RR, Albuquerque UP, editors. Ethnozoology: Academic Press; 2018. p. 9–24. doi: 10.1016/B978-0-12-809913-1.00002-8
[32] Öhman A, Mineka S. The malicious serpent: Snakes as a prototypical stimulus for an evolved module of fear. Curr Dir Psychol Sci. 2003;12(1):5–9. doi: 10.1111/1467-8721.01211
[33] MAE. Sistema de Clasificación de los Ecosistemas del Ecuador Continental. Quito, Ecuador: Ministerio del Ambiente del Ecuador, Subsecretaría de Patrimonio Natural; 2013.
[34] Ortega-Andrade HM. Anfibios y reptiles de la Centro-Amazonía de Ecuador: Los Territorios indígenas Achuar, Shiwiar y Sápara de la Cuenca del río Pastaza Environmental & Conservation Programs. In: 60605 USA: Rapid Color Guide # 259. División de Herpetología-Museo Ecuatoriano de Ciencias Naturales y Fundación Ecociencia. Chicago, IL: The Field Museum. 2010. Available from: http://fm2.fieldmuseum.org/plantguides/guideimages.asp?ID=410
[35] Ron SR. Anfibios del Ecuador. Version 2019.0. Quito, Ecuador: Museo de Zoología, Pontificia Universidad Católica del Ecuador. 2020. Available from: https://bioweb.bio/faunaweb/amphibiaweb
[36] Moreno CE. Métodos para medir la Biodiversidad. Zaragoza: M & T - Manuales y Tesis Sea; 2001.
[37] Hammer O, Harper DA, Ryan PD. PAST: Paleontological Statistics software package for education and data analysis. Paleontological Electronica. 2001;4(1):9.
[38] Torres-Carvajal O, Salazar-Valenzuela D, Merino-Viteri A, et al. ReptiliaWebEcuador. Versión 2019.0: Museo de Zoología QCAZ, Pontificia Universidad Católica del Ecuador. 2021. Available from: http://zoologia.puce.edu.ec/Vertebrados/reptiles/reptilesEcuador
[39] Uzendoski MA. Los napo runa de la amazonía ecuaatoriana. Quito, Ecuador: Abya-Yala Quito; 2010.
[40] Whitten NJ. Amazonian Ecuador: An ethnic interface in ecological, social, and ideological perspectives. In: Whitten N, editor. The other side of development in Amazonian ecuador. Quito: Abya-Yala; 1978. p. 13–60.
[41] Ron SR, Venegas PJ, Ortega-Andrade HM, et al. Systematics of *Ecnomiohyla tuberculosa* with the description of a new species and comments on the taxonomy of *Trachycephalus typhonius* (Anura, Hylidae). Zookeys. 2016;630(2016):115–154. doi: 10.3897/zookeys.630.9298