Revista de la Academia Colombiana de Ciencias Exactas, Físicas y Naturales.
47(185):889-901, octubre-diciembre de 2023. doi: https://doi.org/10.18257/raccefyn.1968

Natural Sciences

Original article

Analysis of the distribution and abundance of two species of cat's claw (*Uncaria* sp.) based on the knowledge of Tikuna indigenous communities in the southern Colombian Amazon

Análisis de la distribución y abundancia de dos especies de uña de gato (*Uncaria* sp.) con base en el conocimiento de comunidades indígenas Tikuna del sur de la Amazonia colombiana

Lina Paola Garzón

Universidad Nacional de Colombia, Sede Amazonia, Leticia, Colombia

Abstract

Uncaria guianensis (Aublet) J.F. Gmel and *U. tomentosa* (Willd. ex Roemer & Schultes) D.C., commonly known as cat's claw, are species with medicinal and commercial value in the Amazon region. Given the intensive extraction of forest resources for commercialization in the region, the distribution and abundance of these species there should be determined. So far, the environmental and edaphic conditions influencing *Uncaria tomentosa* growth and density are better known than those of *U. guianensis*. Besides, cat's claw species distribution in the Colombian Amazon has not been sufficiently studied. In this context, the present study was conducted in two indigenous Tikuna communities together with local experts to make the botanical identification of the two *Uncaria* species. Visits were made to register the landscapes and soils where these plants grow. We found that *U. guianensis* has a higher distribution and abundance in the southern Colombian Amazon than *U. tomentosa*. Both species grow in flooded alluvial areas with Entisol-type soils and dryland Oxisol-type soils. *U. tomentosa* grows especially in primary and secondary forest Oxisol soils on drylands. Our findings suggest that none of these two species have a homogeneous distribution in the region, which explains why their use varies from one area to the other.

Keywords: Ethnoecology; Indigenous knowledge; Amazon soils; Cat's claw.

Resumen

Uncaria guianensis (Aublet) J.F. Gmel y *U. tomentosa* (Willd. ex Roemer & Schultes) D.C., conocidas popularmente con el nombre de uña de gato, son especies con valor medicinal y comercial en la región amazónica. Dado que este recurso se extrae del medio natural para su comercialización, es importante determinar su distribución y abundancia en la región. Hay más información sobre las condiciones ambientales y edáficas que influyen en el crecimiento y densidad de *U. tomentosa* que de *U. guianensis* y, en general, el conocimiento sobre su distribución es limitado. En ese contexto, conjuntamente con conocedores locales de dos comunidades indígenas Tikuna, se hizo la identificación botánica de las dos especies, así como recorridos para reconocer los paisajes y suelos donde crecen. Se encontró que *U. guianensis* tiene una distribución más amplia y mayor abundancia en el sur de la Amazonia colombiana que *U. tomentosa*, ya que crece tanto en áreas inundables aluviales con suelos de tipo Entisol, como en zonas de tierra firme con suelos de tipo Oxisol. *U. tomentosa* crece solo en tierra firme, en suelos de tipo Oxisol de bosque primario y secundario. Los resultados sugieren que no existe una distribución homogénea de las dos especies en la Amazonia, lo que explica que una de las dos especies sea más usada en ciertas zonas que en otras.

Palabras clave: Etnoecología; Conocimiento indígena; Suelos amazónicos; Uña de gato.

Citation: Garzón LP. Analysis of the distribution and abundance of two species of cat's claw (*Uncaria* sp.) based on the knowledge of Tikuna indigenous communities in the southern Colombian Amazon. Revista de la Academia Colombiana de Ciencias Exactas, Físicas y Naturales. 47(185):889-901, octubre-diciembre de 2023. doi: https://doi.org/10.18257/raccefyn.1968

Editor: Elizabeth Castañeda

Corresponding autor:
Lina Paola Garzón;
lipgarzonga@unal.edu.co

Received: August 11, 2023
Accepted: December 12, 2023
Published on line: December 18, 2023

Revista de la Academia Colombiana de Ciencias Exactas, Físicas y Naturales.
47(185):889-901, octubre-diciembre de 2023. doi: https://doi.org/10.18257/raccefyn.1968

Introduction

The *Uncaria* (Schreb) genus belongs to the Rubiaceae family and comprises about 60 species with a pantropical distribution (**Gomes *et al*.**, 2016). Only *Uncaria tomentosa* (Willd.) DC. and *Uncaria guianensis* (Aublet) J.F. Gmel. are known in the Amazon region as cat's claw. Both species are widely distributed in humid tropical forests, especially in the Amazon region (**Alvarenga**, 2010), and they are used in traditional medicine to treat degenerative, infectious, and respiratory diseases and tumors (**Garzón**, 2019). *Uncaria* species are known as medicinal herbs commercialized worldwide (**Gomes *et al*.**, 2016). There are cultivation initiatives, but most of the commercialized raw material comes from the natural environment, which has decreased populations, especially in some areas of the Peruvian Amazon (**Domínguez & Castillo**, 2007).

The species differ in the leaf, spine and bark morphology: *U. guianensis* has ovate leaves, strongly twisted hook-like woody spines, and the main stem has a brown outer shell (**Zevallos & Tomazello**, 2010), while *U. tomentosa* is characterized by lanceolate leaves, adult spines sparsely curved downward, and yellowish inner bark (**Zevallos & Flores**, 2003; **Cruz *et al*.**, 2011). They generally grow in secondary forests but can also be found in primary forests (**Gomes *et al*.**, 2016). Although cat´s claw species have been reported in various soil types (dystric Cambisols, Fluvisols, and ortic Acrisols), *U. tomentosa* is more nutritionally demanding than *U. guianensis* (**Domínguez**, 1997).

The most studied and commercialized species is *U. tomentosa*, presumably because it is more abundant than *U. guianensis* (**Gomes *et al*.**, 2016). Some reports on the distribution and abundance of *U. tomentosa* come from Perú (**Quinteros**, 2001; **Domínguez & Castillo**, 2007; **Canales-Springett *et al*.**, 2013), and both species have been studied in the State of Acre in Brazil (**Miranda *et al*.**, 2003). There is no additional information from other areas in the Amazon region. The study by **Zavala & Zevallos** (1996) in Perú is the only one reporting on the soil conditions for their growth and development, and, therefore, edaphological information on *U. guianensis* is limited. In this context, an interdisciplinary study was conducted with Tikuna indigenous communities to understand both species' distribution and abundance in the southern Colombian Amazon and the influence of soil conditions in natural and disturbed areas. This will help to determine whether *U. tomentosa*'s abundance is higher than that of *U. guianensis* as it happens in other areas of the Amazon region.

Materials and methods

Study area

Three areas were selected: one in the indigenous community of San Martín de Amacayacu and the other two in Macedonia. The first area (at 3°46'38″S, 70°18'12″W, on the riverside of the Amacayacu River) has denudation soils, as well as the second one (at 03°53′00″S, 70°11′17″W, on the Amazon River). The third area (at 3°51'21″S, 70°13'19″W), known as Mocagua Island, has alluvial soils (**Figure 1**).

Figure 1. Location of the indigenous communities in the study area

Methodology

The indigenous people with the best knowledge of cat's claw species were identified through a non-probabilistic chain or snowball sampling (**Otzen & Manterola**, 2017). Semi-structured interviews were conducted with them to gather information on variables of interest: common names and species identity, areas in their territory where they grow, and associations with other plants. Tikuna translators helped when the interviewee's first language was not Spanish, and the plant's common names were mentioned also in the Tikuna language. Social mapping (**Vavilinaa & Skalaban**, 2015) helped determine the cat's claw-growing areas in maps made by the participants, including the types of landscapes and soils. With this information, *Uncaria* species roads and observation routes were defined. Given the terrain conditions and the time required in the communities, an area of influence was established following those roads with lengths between 1 and 7 km; these did not cover every locality but allowed us to estimate the distribution pattern of both species.

Based on this cartography, field trips were made with the community experts to search for plants locally recognized as cat's claws. During the trips, they described in their terms the color of the bark, the shape and color of the leaf, the size of the spines, and the changes in landscape types and soil characteristics. Forty-one samples were georeferenced, 38 corresponding to cat's claw individuals (11 of *U. tomentosa* and 27 of *U. guianensis*). There were three samples from other species that some indigenous people indicated as cat's claws: one of *Macfadyena unguis-cati* (L.) A.H. Gentry (Bognoniaceae) and two of *Machaerium* sp (Fabaceae). For confirmation, herbarium samples were collected according to the **Arnelas *et al*.** (2012) methodology and subsequently deposited and identified at the Colombian Amazon Herbarium – COAH, SINCHI Institute.

For the physicochemical analysis, 500 g of rhizospheric soil was collected at 0-10 cm depth in the sampling points with plants. The description of soil types followed the **Peña-Venegas *et al*.** (2015) methodology: indigenous participants mention the characteristics according to the colors and textures observed. Codes were assigned using the Munsell chart of hue, clarity, and purity parameters (**Domínguez *et al*.**, 2012).

Soil samples were analyzed at the Instituto Agustín Codazzi - IGAC soil laboratory in Bogotá, including granulometry, texture class, pH, exchangeable acidity, aluminum saturation, base saturation, total carbon, available phosphorus, cation exchange content (CEC), total bases, and the presence of calcium, potassium, magnesium, and sodium.

Data analysis

The ATLAS.ti 7.0 software served for coding and analyzing the qualitative information from the interviews, and ArcGIS 10.6.1 for the geographic data. First, the sampling points and the observation routes were digitized, and then the area of influence to determine the abundance of the cat's claw species was calculated. This area totaled 25.34 hectares, including the buffer established on the observation routes with a margin of 5 m on each side of the road.

The level of local knowledge of *U. tomentosa* and *U. guianensis* botanical aspects was estimated by the percentage frequency. Species distribution and frequency on the different types of landscapes were also determined. A Kruskal-Wallis non-parametric variance test was performed to establish significant differences with a 5% probability for each soil type, for soils in the study areas and soils associated with the species.

Results

Local identification of Uncaria species

Cat's claw commonly names both Uncaria species in these communities, but "garabato" is also used, albeit less commonly. Indigenous populations in the Peruvian Amazon use it also (**López**, 2006). However, these communities have specific names to identify each species: *U. tomentosa*, for example, is known as white cat's claw (*uña de gato blanca* in

Revista de la Academia Colombiana de Ciencias Exactas, Físicas y Naturales.
47(185):889-901, octubre-diciembre de 2023. doi: https://doi.org/10.18257/raccefyn.1968

Spanish and *michipatü choü* in Tikuna language). The local experts described it as a plant with a green vine and a white inner bark, green, ovate leaves, and a slightly curved spine. *U. guianensis* is locally called red cat's claw (*uña de gato roja*, *michipatü dauü*) and it is identified by its reddish inner bark, reddish leaves on the underside, and fully curled spines (**Figure 2**). Another classification of these species claims that *U. guianensis* is the "male" and *U. tomentosa* is the "female".

Three samples from Macedonia identified as a cat's claw belong to another species. Two *uña de gato roja* samples from Mocagua Island belong to the *Machaerium* sp. genus (Fabaceae), and an *uña de gato blanca* belonged to *Macfadyena unguis-cati* (Bignoniaceae). Although some species reported as cat's claws did not belong to the *Uncaria* genus, it was evident that the experts are very knowledgeable of the morphological characteristics of the species as 90% of the samples were correctly identified as *U. tomentosa* and 89% as *U. guianensis*, which demonstrate locals' expertise in establishing the species location and distribution.

Uncaria species distribution by landscapes

Indigenous communities identified six landscape types where cat's claw species could occur (**Table 1**). This categorization is based on spatial location, temporal aspects of land use, flooding periods, soil types, vegetation cover, and predominant fauna. According to the degree of intervention and the type of vegetation, cultivated land (*chagra* - *ngane* in Tikuna language), stubble (*rastrojo* – ***ĩchikü***), and primary forest (*naimacatüxü*) were identified.

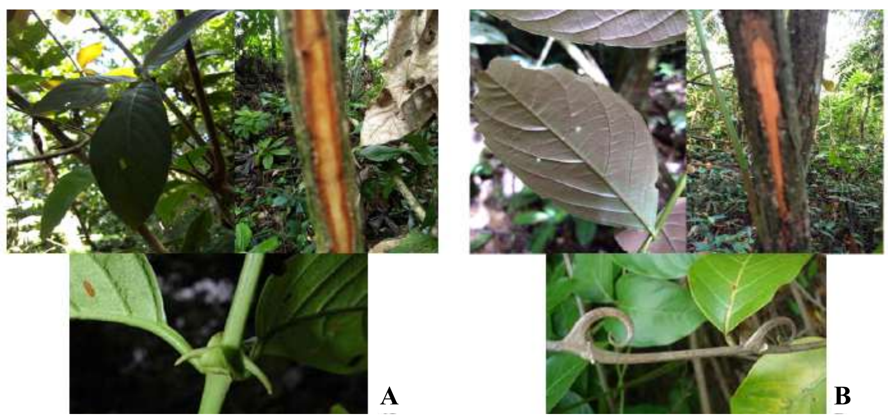

Figure 2. Morphological identification of leaf, bark, and spine of *Uncaria* species. **A)** *Uncaria tomentosa*; **B)** *Uncaria guianensis*

Table 1. Local classification of landscapes in the study area

Common name	Tikuna name	Local description
Stubble on floodplains	ĩchikü nibaiü	Young secondary forest area, which floods seasonally or during heavy rains
Stubble on highlands	ĩchikü *dauchitacüã̱*	Highland or upland area with natural secondary forest
Cultivation area on floodplains	*Ng̱ane nibaiü*	Planting plots in floodable areas
Cultivation area on highlands	*Ng̱ane dauchitacüã̱*	Cultivation area on dry land or high altitude
Primary forest	*Naimacatüxü*	Natural forest area on the highland
Várzea	*Tatű́müànè*	Annual flooded area (Mocagua Island)

The Tikuna also distinguish two divisions in the physical space: the highland areas (*dauchìtáààné*) and the annual flooded areas (*tatüànè*). Depending on the type of flooding, this second space can be divided into floodplains during the rainy months (*várzea*, *tatű́müànè*) and flooded areas during days of prolonged rains (*bajial*, *nibaiü*) (**Montes**, 2002). Field observations showed that U. guianensis distribution and abundance are higher than *U. tomentosa*, especially in flooded areas. There were 1.62 cat's claws individuals per hectare and 1.06 *U. guianensis* individuals in high altitudes and floodplains (**Figure 3**). In contrast, *U. tomentosa* abundance was 0.43 individuals per hectare, restricted to secondary forests in highlands (**Figure 4**). This was the only one observed in mature forests with low intervention.

The highest number of *U. guianensis* plants was found in San Martín de Amacayacu, i.e., 82% of the individuals of this species (**Figure 5**). *U. tomentosa* was more frequent in Macedonia (60%), all in the stubble on highlands (**Figure 6**). None of these species were found on the Mocagua Island.

Regarding the most frequent species in *Uncaria* habitats, in flooded areas, *Scleria secans* (Cyperaceae) and *Calathea lutea* (Maranthaceae) were found with *U. guianensis*, and in the highlands, *Vismia* sp. (Hypericaceae) and *Cecropia* sp. (Urticaceae). In non-flooded areas habitats, *Apeiba membranacea* (Malvaceae) and *Ormosia* sp. (Fabaceae) were frequent next to *U. tomentosa* (**Figure 7**).

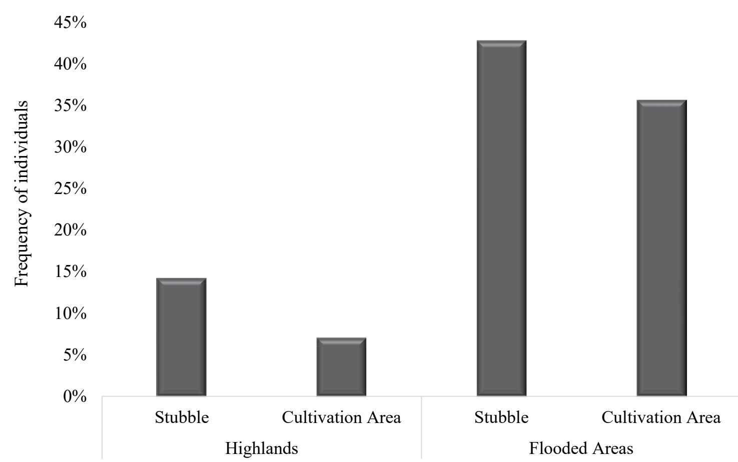

Figure 3. Distribution rate of *Uncaria guianensis* by landscape type

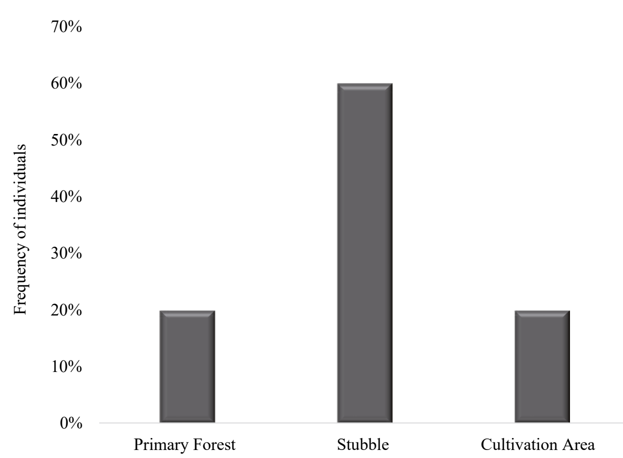

Figure 4. Distribution rate of *Uncaria tomentosa* by landscape

Revista de la Academia Colombiana de Ciencias Exactas, Físicas y Naturales.
47(185):889-901, octubre-diciembre de 2023. doi: https://doi.org/10.18257/raccefyn.1968

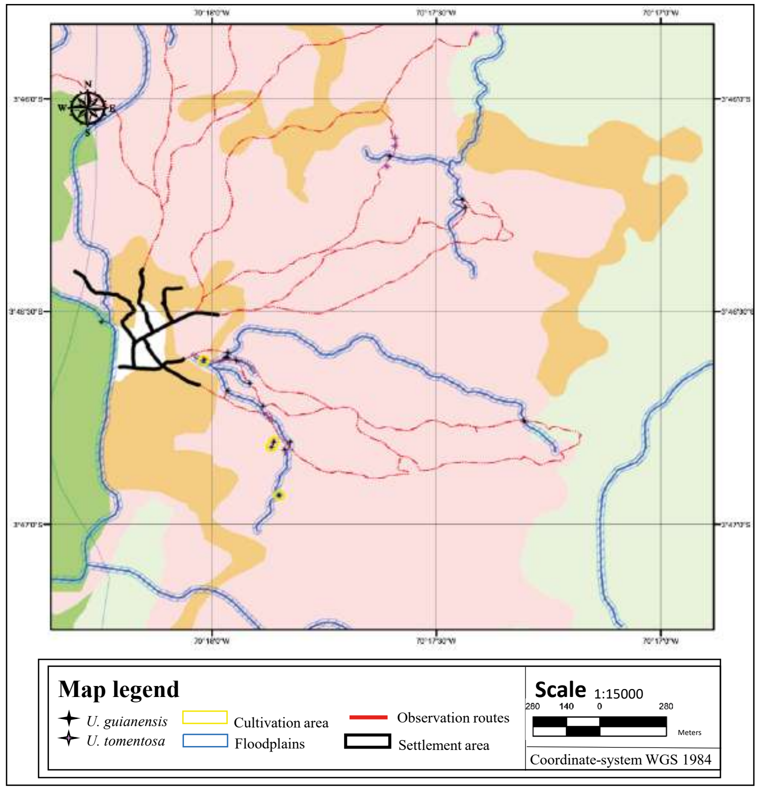

Figure 5. Sampling points and observation routes in San Martín de Amacayacu

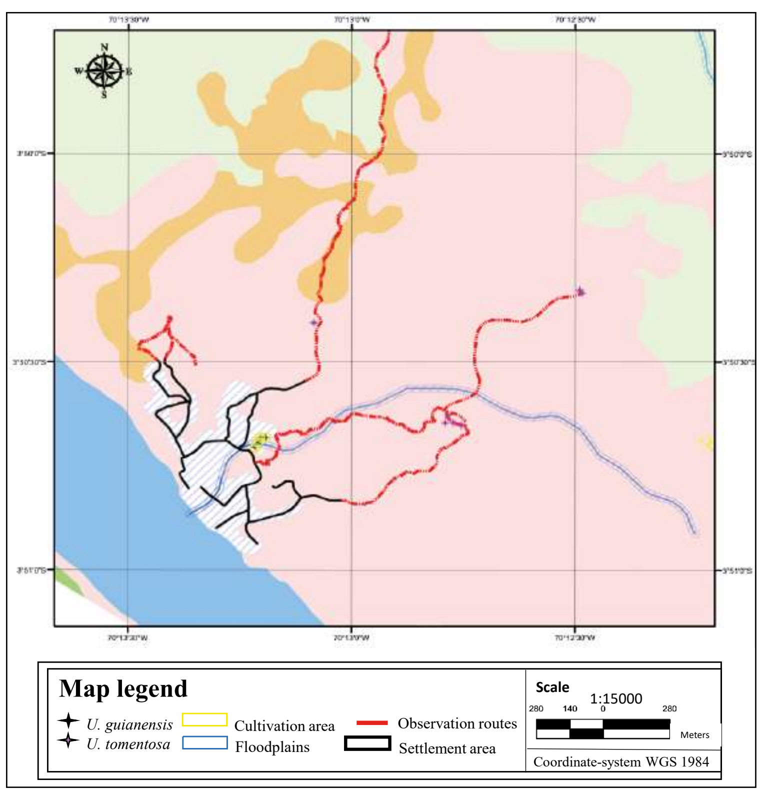

Figure 6. Sampling points and observation routes in Macedonia

Local identification of soils

Local experts identified four common names for three soil classes in which they believe cat's claw species grow (**Table 2**): Oxisols and Entisols (according to the USDA nomenclature system). "Black color layer" (*capa de color negro - wa̱müànèü̃*) and "compost soil" (*suelo abonoso – ĵomüane*) refer to the same kind of soil found in cultivated areas and in dryland stubble. Commonly, soil types receive different names depending on the characteristics they are associated with. The first name is related to the color and the second to the texture. Their properties are described according to their fertility and location in high and flooded areas during the rainy months (*várzeas*) or those flooded on days of prolonged rain (*bajiales*).

Uncaria species distribution by soils

Uncaria guianensis grows in the two soil types evaluated (**Table 3**): 68% of the *U. guianensis* individuals were found in alluvial Entisols and 32% in Oxisols on highlands. *U. tomentosa* was found only in Oxisols on the highlands. According to the soil physicochemical composition in the study areas, the *Uncaria* species grow in soils with diverse textural

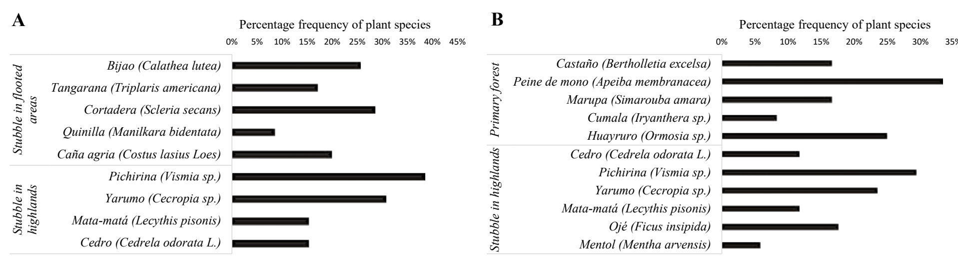

Figure 7. Percentage frequency of most abundant plant species in *Uncaria* species' landscapes. **A)** *Uncaria guianensis*; **B)** *Uncaria tomentosa*

Table 2. Soil types where *Uncaria* species grow

Type of soils	Common name	Tikuna name	Local Description	Edaphic description
Oxisols (10YR 4 3^{-1} Brown)	Black color layer "capa de color negro" Compost soil "suelo abonoso"	*Wa̱müànèü̃* *Ĵomüane*	It is the vegetable layer with a high amount of fertilizer suitable for agriculture. It is found in high-altitude lands in the cultivation areas and stubble.	Very deep, strongly acidic, well-drained, red to strong-brown soils with low base saturation and low organic carbon content.
Alluvial Entisols (7.5YR 3 2^{-1} Dark brown)	Flooded soil "suelo de bajial"	*Nichirü*	It is found in low areas on the banks of streams and rivers. Soil with good fertility that floods annually	Soils with fine and moderately fine textures that are subject to flooding for prolonged periods during the year.
Alluvial Entisols (10YR 4 4^{-1} Dark yellowish brown)	Muddy soil "suelo barroso"	***Ãcharaaneü̃***	The soil on the islands ("várzeas") is soft and fertile, especially for rice.	Soils of medium textures occupying some floodplain shallows that are imperfectly drained and have a base saturation of more than 50% in the first 100 cm.

Revista de la Academia Colombiana de Ciencias Exactas, Físicas y Naturales. 47(185):889-901, octubre-diciembre de 2023. doi: https://doi.org/10.18257/raccefyn.1968

classes (**Table 4**) categorized as highly (pH less than 4.5) or strongly acidic (maximum pH of 5.5), with low to medium available phosphorus ranging from 5.08 to 15.63 mg/kg and medium to high cation exchange capacity (CEC) from 21.65 to 29.71 cmol(+)/kg.

The statistical results showed a homogeneous physicochemical composition in the corresponding soil types (**Table 5**). Differences were found in the physicochemical composition of Oxisols and Entisols. The concentration of phosphorus (22.94 mg/kg) and sodium (0.14 cmol(+)/kg) were higher in Entisols. On average, the pH levels in soils where *U. guianensis* grows were lower than in *U. tomentosa*.

Table 3. Number of *Uncaria* individuals by area and soil type

Type of area (soils)	*Uncaria* individuals	*Uncaria species*	No. of individuals per species	Abundance (Individuals per Ha)
Highlands (Oxisols)	16	*U. guianensis*	6	0.24
		U. tomentosa	10	0.40
Floodplain (Alluvial Entisols)	22	*U. guianensis*	22	0.86
		U. tomentosa	0	0
Mocagua Island (Alluvial Entisols)	No *Uncaria* individuals were identified			

Table 4. Physicochemical composition of soils identified in Tikuna communities in the study area

Community of San Martín de Amacayacu													
Type of area (soils)	**No. sample**	**Texture**	**pH**	**A.I**	**S.A.I (%)**	**C .T (%)**	**P**	**C.I.C**	**Ca**	**Mg**	**K**	**B.T**	**S.B (%)**
Highlands (Oxisols)	9	F FL FAr	4.1 (0.4)	6.7 (3.0)	77.2 (16.1)	4.5 (1.6)	5.3 (2.1)	21.6 (6.8)	1.0 (1.0)	0.4 (0.3)	0.2 (0.1)	1.7 (1.3)	8.3 (5.0)
Floodplain (Alluvial Entisols)	16	F FL FAr FArA	4.0 (0.3)	7.7 (2.7)	82.5 (14.2)	4.9 (2.7)	5.4 (2.8)	23.0 (9.1)	0.9 (0.9)	0.4 (0.3)	0.20 (0.1)	1.6 (1.3)	7.3 (5.6)
Community of Macedonia													
Type of area (soils)	**No. sample**	**Texture**	**pH**	**A.I.**	**S.A.I. (%)**	**C.T. (%)**	**P**	**C.I.C**	**Ca**	**Mg**	**K**	**B.T.**	**S.B. (%)**
Highlands (Oxisols)	8	F FAr Ar	4.6 (0.6)	5.2 (5.0)	48.4 (44.5)	3.0 (0.9)	5.1 (1.6)	24.1 (4.7)	5.3 (5.6)	1.3 (1.3)	0.21 (0.05)	6.8 (6.8)	27.5 (25.8)
Floodplain (Alluvial Entisols)	6	F FAr Ar FArL	4.5 (0.1)	6.4 (0.7)	39.3 (6.1)	3.6 (1.6)	15.6 (4.1)	29.7 (4.8)	8.5 (1.7)	1.4 (0.2)	0.22 (0.05)	6.8 (6.8)	27.5 (25.8)
Mocagua Island (Alluvial Entisols)	2	Ar	5.1 (0.7)	3.6 (2.6)	18.6 (13.1)	4.2 (0.1)	22.9 (4.4)	37.4 (1.1)	17.2 (5.6)	3.1 (1.4)	0.37 (0.01)	20.9 (6.9)	55.5 (16.9)

Variables are expressed in mean and standard deviation (SD) in parentheses according to the number of soils collected for each soil type. Texture: F = loam; Ar = clay; FL = silt loam; FAr = clay loam; FArA = sandy clay loam; FArL = silty clay loam; FArL = silty clay loam. pH (1:1 in water); A.I = Exchangeable acidity with KCl in cmol(+) kg^{-1}; S.A.I% = Percentage saturation exchangeable acidity with KCl; C.T% = Percentage total carbon with complete oxidation; P = Phosphorus available by Bray II in mg/kg; C. I.C = Cation exchange capacity with neutral ammonium acetate in cmol(+) kg^{-1}; Ca = Calcium by DTPA in cmol(+) kg-1; Mg = Magnesium by DTPA in cmol(+) kg^{-1}; K = Potassium by DTPA in cmol(+) kg^{-1}; B.T. = Total bases; S.B.% = Percent saturation of bases with neutral ammonium acetate

Table 5. Non-parametric test for physicochemical soil composition

Physicochemical variables	Soil type Oxisol	Soil type Alluvial Entisols	Soils of study areas	Soils associated with *Uncaria* species	Soils associated with *U. guianensis*
pH	0.522	0.536	0.6847	0.006*	0.004*
P	0.522	0.882	0.0044*	0.06	0.502
Na	0.392	0.293	0.038*	0.333	0.005*
A.I	0.286	0.605	0.29	0.227	0.199
S.A.I	0.831	0.066	0.684	0.311	0.002*
C.T	0.088	0.329	0.3718	0.449	0.145
C.I.C	0.088	0.261	0.1229	0.182	0.003*
Ca	0.201	0.317	0.2912	0.551	0.010*
Mg	0.136	0.346	0.6847	0.572	0.748
K	1	0.651	0.5677	0.444	0.135
B.T	0.055	0.132	0.2912	0.166	0.004*
S.B	0.286	0.361	0.6847	0.074	0.003*

* Significant differences at $p \leq 0.05$

The variability in soil chemical properties is reflected in the significant differences in pH, sodium and calcium levels, the percentage of aluminum saturation, the base saturation, and the cation exchange concentration. *U. tomentosa* was found only in Oxisols on drylands with a pH between 3.78 and 5.53, exchangeable aluminum variations ranging from 0.15 to 12.62 cmol(+)/kg, and aluminum saturation percentages from 3.04 to 85.42%. *U. guianensis* grows especially in acidic soils with a pH ranging from 3.43 to 4.62, exchangeable aluminum levels from 4.66 to 12.36 cmol(+)/kg, and aluminum saturation percentages from 29.44 - 95.18%.

Discussion

Local landscape identification

The common names for the *Uncaria* species are associated with the external characteristics of stems, leaves, and spines. For indigenous experts, the most outstanding feature is the shape of the spine, which resembles the anatomical structure of the claw (*patü*) of some animals: *michipatü* [*michi* - cat (*Felis catus*)], *bauepatü* [*baue – charapa* turtle (*Podocnemis expansa*)] or *daupatü* [*dau* - sparrowhawk (*Buteo* sp.)]. Although there is no clear explanation for the gender differentiation between these species, some local experts make this distinction based on their healing. *U. tomentosa* is the “female” and *U. guianensis* is the “male”. They consider that “males” have more medicinal uses and effectiveness in healing. The non-*Uncaria* species identified here have been reported before in other studies in the Amazon region (**Obregón,** 1995; **Domínguez,** 1997). The *Machaerium* genus, especially *Machaerium nyctitans*, is more commonly associated with the name “cockspur” (*espuela de gallo* (**Bisby *et al.,*** 1994)). *Macfadyena unguis-cati* had previously been reported in Colombia with the name cat´s claw and in Perú with bat´s claw (**Gallegos**, 2017).

In the study communities, *Uncaria* species are well distinguished, but many species are associated with the name cat’s claw in the Amazon region. **Domínguez** (1997) reported 22 species called cat’s claw in Perú belonging to the Bignoniaceae, Caesalpinaceae, Liliaceae, Mimosaseae, Rosaseae, Rutaceae, Sterculeaceae, and Fabaceae families. **Beutelspacher & Farrera-Sarmiento** (2015) reported 31 species in México where other families (Cactaceae, Cannabaceae, Loginiaceae, Martyniaceae, Nyctaginaceae, Solanaceae, and Verbenaceae) have been found. The number of botanical families related to this common name is evidence of the confusion in identifying their botanical characteristics. The name

Revista de la Academia Colombiana de Ciencias Exactas, Físicas y Naturales.
47(185):889-901, octubre-diciembre de 2023. doi: https://doi.org/10.18257/raccefyn.1968

is used by local peoples in the Amazon region for plants with similar anatomical structures, especially the presence of the spine (**Beutelspacher & Farrera-Sarmiento**, 2015). The correct determination of cat's claws is crucial for their medicinal use. **Obregón** (1995) points out that misidentification can lead to social and health problems, as some species may be toxic or may not have the pharmacological properties against specific diseases.

Uncaria species distribution by landscapes

San Martín de Amacayacu has more streams than Macedonia, so there may be more floodable areas that favor *U. guianensis* development and growth in this territory. Although *Uncaria* species are not cultivated directly in the *chagras*, usually remnant plants are left as they are considered medicinal. People sometimes preserve the seedlings that have grown spontaneously in the stubble when prepared for new *chagras*. Likewise, when these cultivation areas are abandoned to let the soil rest, the plant can grow and continue its propagation, as these species have no cultural relevance for the Tikuna people and are considered invasive.

Uncaria species distribution and abundance patterns are similar to **Miranda *et al*.** (2003) reports in the State of Acre, in the Brazilian Amazon, with a higher number of *U. guianensis* individuals per hectare than *U. tomentosa* in areas of 200 m.a.s.l. on average. However, *U. guianensis* abundance in the study area was higher (24.02 individuals per hectare), especially in flooded areas, and its distribution in the southern Colombian Amazon is related to its ability to grow in low areas between 100 and 800 m.a.s.l., near big rivers or second and third order streams. Due to crop rotation in indigenous communities, *U. guianensis* is commonly found in stubble fields because it usually colonizes the area after planting ceases. Its presence in *chagras* and stubble fields responds to its ephemeral heliophyte life form. *U. guianensis* is more susceptible to luminosity levels; as sun rays in open areas reach the soil with medium effectiveness, they promote its development (**Zevallos-Pollito *et al*.**, 2000).

As for *U. tomentosa,* some nearby species support for its entanglement and growth in disturbed areas of primary and secondary forests, and its heliophyte life form requires less light consumption to regenerate (**Zevallos-Pollito *et al*.**, 2000). The abundance of *U. tomentosa* in the study areas was low compared to those registered by **Quinteros** (2001) and **Canales-Springett *et al*.** (2003) Ucayali and Huánuco forest reserve areas in the Peruvian Amazon. They found 51 individuals per hectare in undisturbed forests and 900 individuals per hectare in mature disturbed forests.

The Macedonia and San Martín de Amacayacu indigenous communities in the Colombian Amazon have high population densities, which puts additional pressure on the abundance and distribution of the natural populations of *Uncaria* species. Self-consumption agricultural production plots may have implied high levels of intervention in the territory, especially in secondary forests where many wild species are removed, including cat's claws. This anthropic intervention would explain the differences between this and **Quinteros**' study (2001), which was conducted in areas of undisturbed forest.

Local identification of soils

The four soils identified in the communities are Oxisols and Entisols (USDA classification). Although local experts mentioned that muddy soil (alluvial Entisols) favors plant growth, none of the *Uncaria* species were found in this soil. These soils correspond to the first layer, i.e., the A horizon, at approximately 15 cm. The Tikuna relate these soils directly to the layer that provides the necessary nutrition for plants to grow because the microbial activity is restricted to the first 20 cm of these soils (**Peña-Venegas *et al*.**, 2007), which is essential for the species to absorb phosphorus and other nutrients for their growth and development.

Uncaria species distribution by soils

Uncaria tomentosa was identified in loam-textured and clay loam soils. According to **Quinteros** (2001), the texture does not have a significant effect on the abundance of this species, while **Mechán *et al*.** (2007) have reported that *U. tomentosa* grows better in clay loam soils in the Aguaytía river basin (Ucayali, Perú), as those soils have greater aeration capacity and water availability, which facilitates the absorption of nutrients. Here, this species was the only one observed in primary and secondary forests, but no relevant differences were observed in the composition of the soil samples.

Peña-Venegas & Cardona (2010) reported a close relationship between highlands successional forests biogeochemical cycles in the southern Colombian Amazon. They found that they tend to be more acidic than those of the Ucayali region studied by **Domínguez & Castillo** (2007). In the acidity measurements, aluminum saturation percentages were above 60% in the Colombian Amazon, which can affect the species' growth by decreasing its capacity to absorb water and nutrients.

The abundance of *U. tomentosa* (0.40 individuals per hectare) is low compared to the values reported by **Quinteros** (2001) in the Ucayali region (51 individuals per hectare in undisturbed forests). The author points out that the available phosphorus content (estimated at 3.62 mg/kg) is directly related to the abundance of the species. However, in our study, there was no significant difference in this edaphic variable (5.34 mg kg^{-1}), so other factors must be responsible. *U. guianensis* is the cat's claw species that grows in the most acidic soils, with higher exchangeable aluminum levels and saturation percentages ranging from 29.44 to 95.18%. These results support the data reported by **Zavala & Zevallos** (1996) in the Peruvian Amazon, where they concluded that *U. guianensis* grows in more acid soils than *U. tomentosa*. This species has a greater capacity to adapt to the variability of physicochemical conditions in soils of secondary forests and is less demanding in nutritional terms than *U. tomentosa* (**Domínguez**, 1997).

Although the alluvial Entisols in the study areas tend to be less acidic, there were no significant differences concerning the Oxisols. It cannot be said that pH is conditioning *Uncaria* growth, and other edaphological characteristics should be considered to explain the changes in these species growth, for example, drainage conditions; when these are good, aeration and organic matter mineralization processes are favored, which facilitates the nutrition of various plant species (**Monsalve *et al.***, 2017). Oxisols are highly evolved, deep, and well drained soils, while alluvial Entisols are not so well-evolved and tend to have low depth and poor drainage (**IGAC,** 2015). The distribution of *Uncaria* species in these soil types coincides with the report of **Zevallos-Pollito *et al.*** (2000) that found *U. tomentosa* individuals only in well-drained soils, which commonly favor its growth, while *U. guianensis* was more abundant in poorly drained soils (**Quevedo**, 1995). More detailed research on the physical, chemical, and biological characteristics of soil types is required to clarify the behavior of *Uncaria* population distribution.

On the other hand, the physicochemical composition of the soil on Mocagua Island is not a limiting factor for the cat's claw growth. **Quevedo** (1995) has documented that the dispersal range of these plants is wide as the wind disperses their filiform seeds. The indigenous communities' establishment of plots for agricultural production reinforces the idea that anthropogenic intervention has influenced the population density of *Uncaria* species in the study areas.

Conclusions

The local Tikuna experts showed good botanical knowledge of the cat´s claw species. Theirs is a crucial contribution that facilitates the location and estimation of their abundance and enhances the reliability of their medicinal products. *U. guianensis* was the most abundant species both in upland and floodplain areas. It is well-adapted to the predominant soil types, and the edaphological differences do not directly affect its distribution. *U. tomentosa* was found only in mature highlands. The variations in edaphoclimatic conditions throughout the Amazonian territory make it impossible to consider a homogeneous pattern of distribution and abundance for *Uncaria* species in this region. The abundance and natural regeneration of *Uncaria* species seem to be adversely affected by the water table and the intervention of the communities in the forests to extract them for medicinal uses. Therefore, it is necessary to implement planting strategies for these species *in situ* according to habitat and soil types.

Acknowledgments

To the indigenous authorities of Macedonia and San Martin de Amacayacu for allowing us to work with their communities. Special thanks to the experts who taught us about the growing conditions of cat's claw species for their approval to socialize their knowledge in the academic environment. To the Instituto Amazónico de Investigaciones Científicas, Sinchi, for its help in identifying the species. This work was funded by the Ministerio de Ciencia, Tecnología e Innovación (MINCIENCIAS), National Doctorates Program No. 757 of 2016.

Conflicts of interest

There is no conflict of interest as concerns the development of this research through to the production of this manuscript.

References

Alvarenga, S. (2010). Establecimiento in vitro y cultivo de células de la uña de gato (*Uncaria tomentosa*) (Willd.) D.C. *Tecnología en Marcha*, *23*, 24-33.

Arnelas, I., Invernón, V. R., González, M. E., López, E., Devesa, J.A. (2012). Manual de laboratorio de botánica. El herbario. Recolección, procesamiento e identificación de plantas vasculares. *Reduca (Biología). Serie Botánica*, *5*(2), 15-24.

Beutelspacher, C. & Farrera-Sarmiento, O. (2015). *Uncaria tomentosa* (Wild.) DC. (Rubeaceae) y las falsas "uñas de gato" en México. *Lacandonia*, *9*(2), 21-32.

Bisby, F., Buckingham, J., Harborne, J. B. (1994). *Phytochemical Dictionary of the Leguminosae.* Chapman and Hall.

Canales-Springett, A. W., Ceroni, A., Dominguez, G., Castillo, **A.** (2013). The effect of light on the natural regeneration of *Uncaria tomentosa* (Willd) DC "cat's claw", in a forest ecosystem at the "bosque nacional Alexander von Humboldt", Pucallpa - Perú. *Ecología Aplicada*, *12*, 99-109.

Cruz, N., Brenes, M., Abdelnour, A., Alvarenga, S. (2011). Establecimiento de un protocolo para la conservación in vitro a mediano plazo de uña de gato (*Uncaria tomentosa* (Willd). D.C.). *Tecnología en Marcha*, *24*, 19-29.

Domínguez, G. (1997). *Uña de gato. Producción sostenible.* Universidad Agraria de la Molina.

Domínguez, G. & Castillo, A. (2007). Growth of an *Uncaria tomentosa* (Willd.) DC. clone in four habitat conditions of the Aguaytia river basin, Ucayali Perú. *Ecología Aplicada*, *6,* 39-46.

Domínguez, J. M., Román, A. D., Prieto, F., Acevedo, O. (2012). Sistema de notación Munsell y CIELab como herramienta para la evaluación de suelos. *Revista Mexicana de Ciencias Agrícolas*, *3*(1), 141-155.

Gallegos, X. F. (2017). Etnobotánica cuantitativa de la comunidad nativa infierno, Madre de Dios - Perú. *Revista Etnobiologia*, *15*(3), 24-40.

Garzón, L. P. (2019). Medicinal uses of cat's claw (*Uncaria tomentosa* (Willd. ex Roemer & Schultes) DC and *Uncaria guianensis* (Aublet) J.F. Gmel) by Tikuna communities from the southern Colombian Amazon. *Ethnoscientia*, *4*, 1-15.

Gomes, I. C., Bertoniii, B. W., Soares, A. M. (2016). *Uncaria tomentosa* and *Uncaria guianensis* an agronomic history to be written. *Ciência Rural, Santa Maria*, *46*(8), 1401-1410.

Instituto Geográfico Agustín Codazzi - IGAC. (2015). *Estudio General de Suelos y Zonificación de Tierras de Amazonas.* Instituto Geográfico Agustín Codazzi.

López, M. T. (2006). Uña de gato. Características y perfil terapéutico. *Offarm*, *25,* 104-108.

Mechán, T. E., Alegre, J. Domínguez, G. (2007). Edaphic variability influence on the biomass production of cat'claw *Uncaria tomentosa* (Willd) D.C. in the Aguaytia Watershed, Ucayali, Perú. *Ecología Aplicada*, *6*, 33-37.

Miranda, E., Souza, J. A., Pereira, R. (2003). Caracterização e avaliação de populações nativas de unha-de-gato [*Uncaria tomentosa* (Willd.) D.C. e *U. guianensis* (Aubl.) Gmel.] no Vale do Rio Juruá-AC. *Revista Brasileira de Plantas Medicinais*, *5*, 41-46.

Monsalve, O. I., Gutiérrez, J. S. Cardona, W. A. (2017). Factors involved in the process of nitrogen mineralization when organic amendments are added to a soil. A review. *Revista Colombiana de Ciencias Hortícolas*, *11*, 200-209.

Montes, M. E. (2002). *Capítulo IV. Medio Ambiente*. En: F. Ahué, B. Ahué and V. Angarita (Eds). *Libro guía del maestro. Materiales de lengua y cultura ticuna* (p.p 73-93). Facultad de Ciencias Humanas, Departamento de Lingüística, Universidad Nacional de Colombia.

Obregón, L. (1995). Right identification of Cat´s claw (genius *Uncaria*). *Natura Medicatrix*, *40*, 28-30.

Otzen, T. & Manterola, C. (2017). Sampling Techniques on a Population Study. *International Journal of Morphology*, *35*(1), 227-232.

Peña-Venegas, C. P., Cardona, G., Arguelles, J. H., Arcos, A.L. (2007). Micorrizas arbusculares del sur de la Amazonia colombiana y su relación con algunos factores fisicoquímicos y biológicos del suelo. *Acta Amazónica*, *37*, 327-336.

Peña-Venegas, C.P. & Cardona, G. (2010). *Dinámica de los suelos amazónicos: Procesos de degradación y alternativas para su recuperación*. Instituto Amazónico de Investigaciones Científicas - Sinchi.

Peña-Venegas, C. P., Stomph, T. J., Verschoor, G., Echeverri, J. A. Struik, P. C. (2015). Classification and use of natural and anthropogenic soils by indigenous communities of the upper Amazon region of Colombia. *Human Ecology*, *44*, 1-15.

Quevedo, A. (1995). *Silvicultura de la uña de gato. Alternativas para su conservación*. Instituto de Investigaciones de la Amazonía Peruana - IIAP.

Quinteros, B. (2001). Distribución natural y determinación edafoclimática de la *Uncaria tomentosa* (Wild) D.C. y *Uncaria guianensis* (Aubl) Gmel (Uña de gato) en la cuenca del Río Aguaytía (Tesis de pregrado), Facultad de Ciencias Forestales de la Universidad Nacional de Ucayali.

Vavilinaa, N. D. & Skalaban, I. A. (2015). Social mapping as a tool for public participation. *Regional Research of Russia, 5*(1), 66-72.

Zavala, C. A. & Zevallos, P. A. (1996). *Taxonomía, distribución y status del Género Uncaria en el Perú. "Uña de Gato".* Universidad Agraria La Molina.

Zevallos, P. A., Lombardi, I., Bernal, H. Y. (2000). *Agrotecnología para el cultivo de uña de gato o bejuco de agua*. En: J. V. Martínez, H. Y. Bernal, A. Cáceres (Eds.). Fundamentos de agroecología de cultivo de plantas medicinales iberoamericanas (pp. 463-492). Programa Iberoamericano de Ciencia y Tecnología para el Desarrollo (CYTED).

Zevallos P. A. & Flores, Y. (2003). Caracterización morfológica de plántulas de "uña de gato" *Uncaria tomentosa* (Willdernow ex Roemer & Schultes) D.C. y *U. guianensis* (Aublet) Gmelin del Bosque Nacional Alexander Von Humboldt. *Ecología Aplicada*, *2*, 41-46.

Zevallos-Pollito, P. A. & Tomazello, M. (2010). Levantamento e caracterização de duas espécies do gênero *Uncaria* schreb. (Rubiaceae) correntes no estado do Acre, Brasil. *Ecología Aplicada*, *9*(1), 19-30.