UNIVERSIDAD DE INVESTIGACIÓN DE TECNOLOGÍA EXPERIMENTAL YACHAY

Escuela de Ciencias Biológicas e Ingeniería

TÍTULO: Biodiversity of arachnids (Araneae) in eco touristic places in Imbabura, northern of Ecuador

Trabajo de integración curricular presentado como requisito para la obtención del título de Biólogo

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Resumen

La presente tesis inicia presentando una introducción a la historia y características generales del orden de las arañas y su relación con los humanos. Luego, un resumen de terminologías de la morfología que son útiles para la identificación de arañas. Luego, se analiza la escasez de los estudios de biodiversidad de este orden en el Ecuador y su importancia.

Para el registro de arañas se visitó sitios eco-turísticos en la provincia de Imbabura, como, la cascada de Conrayaro y el jardín botánico de Yachay. Se logró fotografiar y registrar 50 distintas especies de arañas. Sin embargo, en algunos casos se identificó a nivel de género o nivel de familia. Con lo cual, del trabajo realizado en campo, se obtuvo un registro fotográfico y descriptivo de 30 morfoespecies de arañas.

La plataforma iNaturalist fue utilizada para registrar e identificar la mayoría de especies fotografiadas. Además, de su base de datos, se usó el registro de observaciones dentro de la provincia de Imbabura durante los últimos 2 años (2019-2020). En total 550 observaciones distribuidas por toda la provincia, dieron un panorama general de lo que se podría encontrar en cuanto a familias de arañas se refiere. De aquí, calculando la abundancia relativa de las familias más abundantes de la plataforma y del trabajo en campo, se determina que las familias Araneidae, Lycosidae, Theridiidae, Salticidae y Tetragnathidae, son las más abundantes en la provincia de Imbabura.

Se provee un análisis de MaxEnt (máxima entropía) permite predecir la distribución de las familias de arañas en todo el Ecuador en la sección Apéndices de esta tesis.

Finalmente se recomienda análisis taxonómicos más profundos para determinar si se distinguen nuevas especies de arañas para el Ecuador y para la ciencia.

Palabras clave:

Arañas, biodiversidad, morfoespecies

Abstract

This thesis begins with an introduction to the history and general characteristics of the spider order and its relationship to humans. This is followed by a summary of morphological terminologies that are useful for spider identification. Then, the scarcity of biodiversity studies of this order in Ecuador and its importance is analyzed.

For the registration of spiders, we visited eco-tourist sites in the province of Imbabura, such as the Conrayaro waterfall and the botanical garden of Yachay. Fifty different species of spiders were photographed and recorded. However, in some cases they were identified at the genus or family level. Thus, from the field work, a photographic and descriptive record of 30 morphospecies of spiders was obtained.

The iNaturalist platform was used to record and identify most of the species photographed. In addition, from its database, the record of observations within the province of Imbabura during the last 2 years (2019-2020) was used. In total 550 observations distributed throughout the province, gave an overview of what could be found in terms of spider families. From here, calculating the relative abundance of the most abundant families from the platform and field work, it is determined that the families Araneidae, Lycosidae, Theridiidae, Salticidae and Tetragnathidae, are the most abundant in the province of Imbabura.

A MaxEnt (maximum entropy) analysis is provided to predict the distribution of spider families throughout Ecuador in the Appendices section of this thesis.

Finally, further taxonomic analysis is recommended to determine if new spider species are distinguished for Ecuador and for science.

Keywords:

Spiders, biodiversity, morphospecies

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1: Introduction

1.1. The spiders.

If you see a "bug" walking on silk threads,
or producing it, it is 100% sure that it is a spider.

Spiders, Araneae, is one of the most megadiverse orders within the Arachnida; with 112 families, about 3,880 genera, and more than 43,000 species (Grismado et al., 2015). Spiders are distributed worldwide and they are part of most ecological niches. Spiders date back to more than 300 million years ago during the late Carboniferous period, and in their passage, through the earth, they have diversified in such a way that they have been able to remain as one of the best-adapted predators in the invertebrate world (Garwood et al., 2016); they possess so much diversity in morphology, hunting methods and in aspects such as their production of spider silk, that these are vital characteristics that we should keep an eye on for possible future studies for the benefit of humans.

Their distribution is so large that spiders can be found from sea level to near 7000 meters above sea level on Mount Everest (Aldana, 2011). This implies all those unique and extreme climates, ranging from inhabiting Antarctica, deserts, as well as certain individuals that have adapted to live underwater despite having aerial respiration, to the hostile wastelands, where the sun's radiation and its temperature result in an extreme climate for life in general.

All spiders are carnivorous and they have poison glands to kill their prey. (Rainer F. Foelix, 1943). They possess a wide diversity of strategies to hunt their victims that in short, there are two methodologies, some weave a web to capture their prey and others stalk them. (Grismado et al., 2015), in fact, this characteristic is also used to taxonomically identify certain groups of spiders.

1.2. Human-spider relationships

Spiders highly interact with to humans, they can be found inside human buildings, yards, and parks and, therefore, encountering one of these animals is very frequent. Thanks to this continuous contact and the fact that some spiders spin a large and attractive web, it is very easy for humans to recognize these animals. However, a minimal variety of species are those that enter or live near human settlements, and those that do, because

of their diet ranging from insects, worms, crustaceans, small vertebrates, and other arachnids (Rainer F. Foelix, 1943), the vast majority of spiders can represent a benefit to people by eliminating pests within the home. In addition, due to misinformation, movies, and documentaries on certain types of spiders, it is thought that all spiders represent a health hazard, and it is common for people to kill these animals for fear of being bitten, but this is not entirely true. Only 4 genera, out of almost 4000 which represents about 0.001%, are classified as of medical importance. This means that the bite of an individual belonging to these 4 genera, may present complications that require hospitalization to alleviate the symptoms of the toxicity of their venom, and in the most extreme cases, amputation of affected areas is necessary, or even death is possible. These genera include *Phoneutria*, the banana spider; *Loxosceles*, better known as fiddler spiders, corner spiders or recluse spiders; *Latrodectus*, within which the famous black widow is found; and *Atrax*, which is endemic to Australia. (Gómez-cardona, 2020).

1.3. Anatomy and morphology

For the identification of spiders, it is most common to be guided by the external anatomical parts; therefore, reviewing their anatomy and morphology is essential for this study because it will serve for the identification of the individuals found. However, in some cases it will only be possible to reach a genus or family level.

The size of spiders varies from minuscule individuals of 2 mm in length to the largest tarantulas that can measure up to 90 mm. This measurement is only of the body, not including the extension of their legs (Rainer F. Foelix, 1943). The body of a spider is composed of two main parts: the prosoma or cephalothorax, which is the front part, and the opisthosoma or abdomen, which is the back part of the spider, both of which are joined by a narrow structure known as the pedicel (Enriquez, 2016).

The prosoma generally contains the structures necessary for locomotion, feeding, and the central nervous system. On the other hand, the opisthosoma is responsible for vegetative tasks such as digestion, respiration, excretion, silk production, and reproduction (Rainer F. Foelix, 1943).

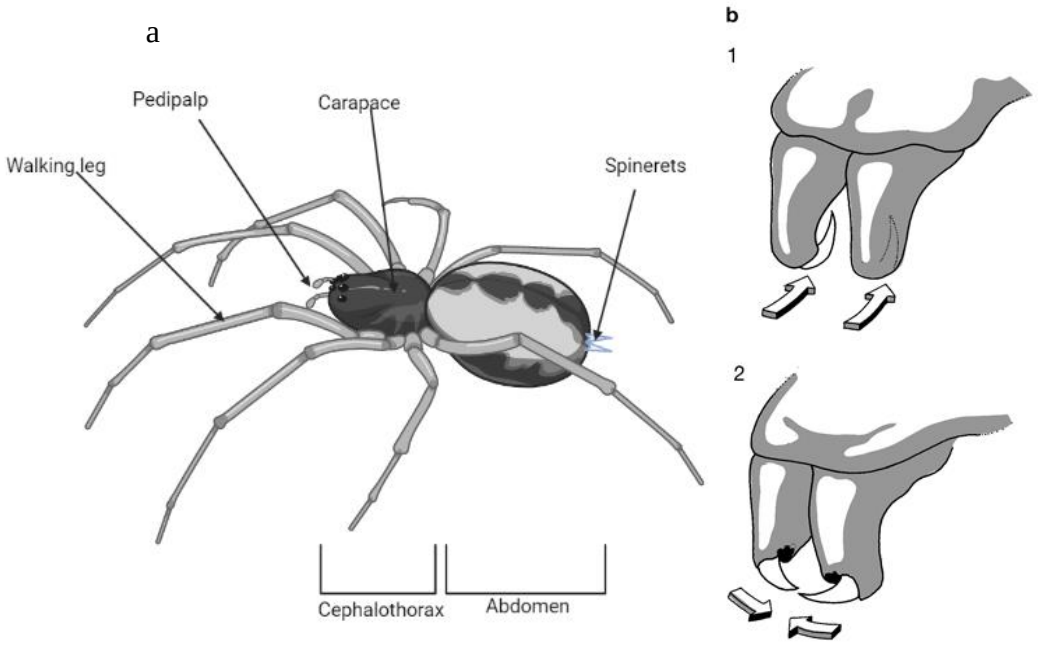


Figure 1. General morphology of a spider

(a) External morphology of a spider (b) direction of movement of Chelicerae. 1 Mygalomorph spider, 2 Labidognath spider. (Rainer F. Foelix, 1943)

The prosoma is the site where the four pairs of legs are anchored, two leg-like but smaller structures called pedipalps, which, in adult males, become the reproductive organ, and a pair of chelicerae that, depending on the sub-order they belong to, will move parallel or opposite to each other (Figure 1 b). In turn, the mouthparts used for feeding are located just behind the chelicerae; spiders cannot eat prey directly, but after being inoculated with venom, they also inject digestive fluids that dissolve the organism on which the spider is going to feed (Walter et al., 2017). Also, in the frontal part are found the eyes, which are generally 8, but there are species with 6, 4, 2, or even without eyes (Zapana, 2017). All these characteristics are used to taxonomically identify spiders; the sexual organs, the arrangement, and number of eyes, the arrangement of the chelicerae, the arrangement and size of the legs, can serve to identify them at the species level (Rainer F. Foelix, 1943).

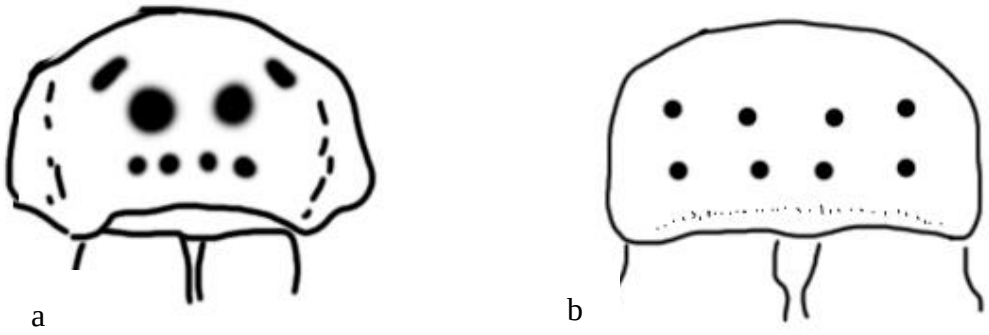


Figure 2. Eye pattern in different spider species

Eye pattern in (a) the wolf spider *Lycosa* and (b) the orb-weaver *Tetragnatha*. The disposition of the eyes is a key to identify species of spiders (Rainer F. Foelix, 1943).

The opisthosoma contains the spider's digestive system, lungs for respiration, and female sexual organs in a structure called the epigynum. They also have modified appendages called spinnerets or spinnerets, which are weaving organs that work together with the silk-producing glands to form silk threads, and in the posterior part is the anus, to dispose of food debris (Aldana, 2011; Rainer F. Foelix, 1943; Zapana, 2017).

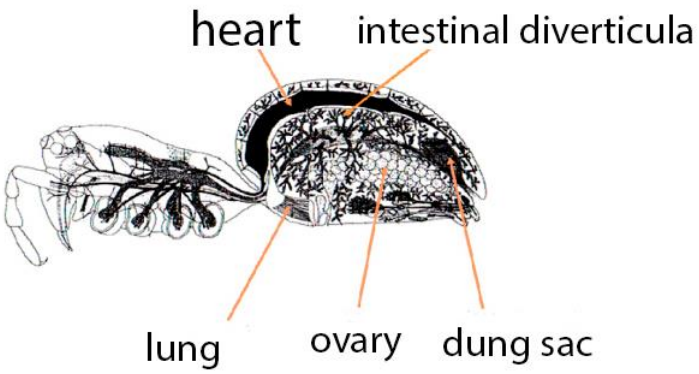


Figure 3. Internal anatomy of a spider.

Taken from Biology of spiders,(Rainer F. Foelix, 1943).

1.4. Biodiversity

Despite the fact that spiders are conspicuous, that is, they are relatively easy to find and capture, studies in Ecuador about spider's biodiversity are very scarce (Macias, 2018). There are few scientific articles, thesis works, and other formal projects that have been dedicated to the diversity of arachnid species. It is a pity considering the factors that make the study of spiders interesting, such as the abundance of other species that serve as food, habitat conservation, climate and other abiotic factors (Wheater et al., 2000), which makes them an indicator species of conservation and ecological changes.

There are independent works such as aracnidos.otonga.org with 709 species by the researcher and illustrator Nadine Dupérré, websites specialized in biodiversity such as iNaturalist, ecoregistros.org, projectnoah, and isolated research papers that do not give an accurate number of species recorded for Ecuador. In each research work focused on spider biodiversity, new species are recorded, which means that it is a little-explored field with great potential for research(AVILÉS et al., 2001; Dupérré, 2014; Dupérré & Tapia, 2016).

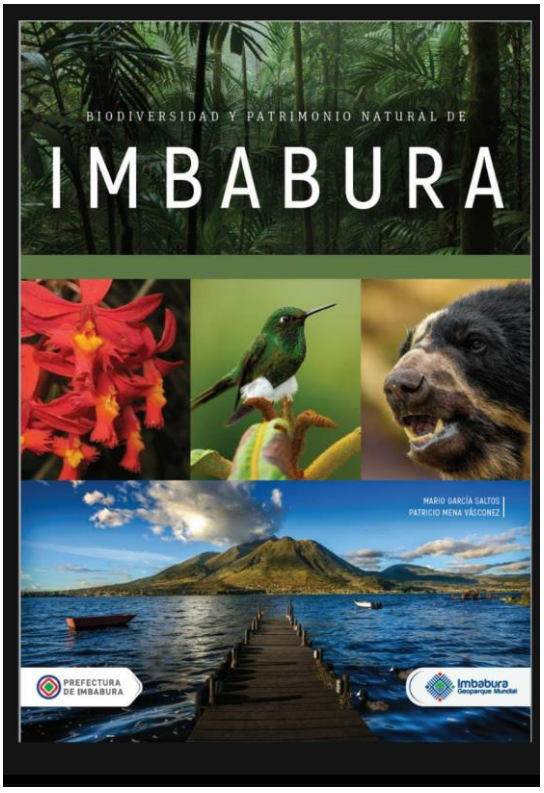


Figure 4. "Biodiversity and Natural Heritage of Imbabura" Book

On July 27, 2021, the prefecture of Imbabura presents the book "Biodiversity and Natural Heritage of Imbabura" which is the result of research conducted in Imbabura

UNESCO Global Geopark. It covers the natural biodiversity, including mammals such as the Andean bear, several species of birds and plants, landscapes ranging from the moors to the Andean forests and dry valleys with great ethnic and cultural diversity. And which aims to be an indispensable tool for teachers and the educational community in general, to strengthen environmental education and promote the conservation of ecosystems.

Figure 5. Specialized and independent websites to register biodiversity.

Sites such as iNaturlalist, otonga.org, aracnidos.otonga.org contains a list of arachnid species of Ecuador

1.5. Other considerations about spiders

It is necessary to highlight not only the importance of studies dedicated to biodiversity in our country but also the importance of spiders in ecological systems. Besides being indicators of climatic changes, they have agricultural-sanitary applications as potential biological control (Pekár, 2005), and a characteristic that is being researched for its industrial application is its spider web.

Spiders have a characteristic that makes them unique in the animal kingdom, the production of spider silk. Insects such as the silk butterfly *Bombyx mori* also produce silk, but only to cover the sacs where their larvae grow. Spiders, on the other hand, produce silk daily, to move around, catch prey and reproduce. Spider silk is a biomaterial that has been researched for nearly 40 years, with great potential for use in the textile, security, and biomedical industries. Thus, the silk of the *Nephila clavipes* spider, which has a golden color, has already been used for the manufacture of bulletproof vests, large textile pieces considered a luxury, and medical prostheses. (Martínez Martínez et al., 2015).

The silk of a spider is different for each species and many types of fibers make up a spider web. Silk is a long protein composed of glycine, alanine, serine, and tyrosine (Zapana, 2017), the combination of these amino acids is what gives its particular property to each of the fibers that make up the different types of threads. The amino acids of each silk are usually very repetitive, for example, in the same spider, in the silk comprising the dragline, the repetitive sequence of amino acids contains a lot of glycine and alanine; on the other hand, the silk used for the egg sac contains a lot of serine and alanine (Hayashi, 2010). Silk threads are produced by up to 6 fiber-producing glands which are: ampullated, pyriform, aciniform, tubulliform, flagelliform, and aggregate (Römer & Scheibel, 2008). Each fiber fulfills a function within a spider web and these functions are summarized in the following table.

Table 1. Type of silk producers' glandules and their function

Thread's type	Producer Gland	Function
Frames	Ampullated	Baselines that support the entire spider web
Sticky	Pyriform	Used to join the web to the substrate and between the fibers
Adhesive	Flagelliform	Capture the prey, they are very elastic and strong, form the spiral of the web
Sticky covering	Aggregate	Stronger adhesion to the prey into the spiral web and keeps the web moistened
Packaging	Aciniform	To wrap the prey once captured
Maternal	Tubuliforms	To build the ovisac

The importance of the study of spider webs is based on the physical and chemical properties that not only make it an essential material for the survival of the spider (Silva & Rech, 2013) but also make it a very attractive biomaterial for its application for the benefit of humanity, whether in the security, space, medical, etc. industry. However, as we do not yet have enough knowledge about spiders, we do not know if we are directing our studies on the right path. Money and research efforts have been directed to spiders:

Nephila clavipes, the Golden orb-weaver, and; *Araneus diadematus*, the European garden spider. After a study by the scientist Cheryl Hayashi, it was shown that these spider species are not those with the strongest silk, but it was a *Scytodes* spider which, because of its particular way of hunting its prey, has the potential to be the strongest silk of all (Hayashi, 2010). Spiders of the genus *Scytodes* also called spitter spiders, catch their prey by expelling a certain amount of silk that envelops them instantly, it must be very rigid to make it impossible for the prey to move and, at the same time, it must be very sticky so that it remains anchored in one place and the more it tries to escape, the more entangled it remains in the silk of this spider. Therefore, knowing first the diversity of spiders and then the characteristics of the spider silk of each of the different genera is vital to continue research on this biomaterial.

It is for this reason that a study of this nature is proposed, to increase our knowledge of the biodiversity of our country, to increase the species register for Ecuador, to raise awareness, and to facilitate and propose future studies on arachnids.

2: Objectives

2.1. General objective

- To record the biodiversity and natural history of spiders in different locations in the province of Imbabura.

2.2. Specific objectives

- To determine the species richness in different areas of northern Ecuador.
- To identify species of different genera for the equator.
- To generate current distribution maps for different individuals.
- To raise awareness about the importance of spiders inside and outside urban areas.
- To raise awareness of the risk to the human population posed by the genera Latrodectus and Loxosceles.
- To increase their biological value and increase and expand the target audience of tourist sites known or focused on animal and plant biodiversity.

3: Methodology

3.1.Study areas

For this study, we first consulted the iNaturalist database with all the observations of arachnids that have been identified at least at the family level, their place of registration and date, made during the last 2 years. These data were then placed on a geographic map. (Fig.8) and based on this, the most common places where spiders are found are identified. The places with the highest number of identifications are the main cities of the province, Atuntaqui, Ibarra, Urcuquí. This analysis was used to propose sample collection sites.

The study was conducted mainly in the province of Imbabura in Ecuador, areas visited by tourists for their biodiversity were chosen, such as the botanical garden of the Yachay Tech University and the viewpoint of the Andean bear, as well as protected areas, and areas intervened by the agricultural and livestock sector as in the case of the Timbuyacu and an agricultural property about 10km from Lita.

In addition, we also carried out the registry in cities where the researcher and collaborators could monitor almost daily, in the urban environment within the home, as well as in yards and land within the same property.

Figure 6. Collection points during field work in Imbabura province, northern Ecuador.

3.2.Census method

Sampling and experimentation of the methodology to be followed from January 2021, photographing and recording the first spiders on the list.

First, a methodology was developed to follow the trail of a spider, when looking closely at a wall, a plant, a tree, on the road, etc. Either in the countryside or in the city, you get to see threads of spider silk and many times small debris, leaves or dust stick to these rows that are left during the movement of an individual so there is most likely a spider nearby. In some cases, it is orbicular web spiders and in others irregular web spiders. In certain corners, there are small burrows, a set of bulging webs, which also demonstrates the presence of an individual and we proceed to search the vicinity of the areas. In specific cases, we also get to see silk threads placed in the form of tunnels at the entrance of holes in the floor, walls, or in hollow trunks and gives us small clues of what species we can find, generally species of the superfamily of spiders with 8 eyes, Lycosoidea, and the suborder Mygalomorphae.

For the field sites, we took advantage of the trails marked as transects and searched both sides of the road to record those species that are easily accessible to any visitor.

Inside the homes, we proceeded to check the corners, cracks, behind furniture, drawers, boxes, closets, practically every corner in search of spider webs and after finding some trace, we proceeded to check the surroundings in search of spiders.

Measurements of the individuals were taken in two ways: one way was to measure the specimen directly with a ruler placed on a surface and the length was measured from the outermost tip of the prosoma to the end of the opisthosoma to have a measurement of the spider's body and also the extension of the legs was measured from the tip of the front legs to the end of the hind legs or, depending on the case, the measurement was also done horizontally. The other way was through photographs. The same zoom power of the camera was used with the closest focal length at which the individual was seen and compared with a photograph that was taken with the same zoom level and focal length of a millimeter ruler, thus obtaining the same two measurements previously mentioned, that of the spider's body and the total length of its legs.

3.3.Taxonomic identification of the individuals

Photographs were taken in situ of the individuals found, which were then developed in Photoshop, having been captured in raw format to ensure maximum image quality. These images are then uploaded to the iNaturalist website where, by their algorithm, they give suggestions of species that are visually similar to those photographed. However, this is not enough and a manual comparison of photographs from the database and photographs taken in the field must be made. In addition, with the help of expert arachnologists who were contacted through identification groups in social networks, they helped with the suggestion and confirmation of some observations.

4: Results and discussion

4.1. Identified families, genera and species

This section describes all the families, genera and in some cases species, which were found during the research through field trips. It will also contain data by way of the natural history of the individuals found. This list is important to give a broad vision of the diversity of spiders that can be found in the province of Imbabura. Thus, other researchers or those interested in arachnids can make use of this information as a guide to identifying the different individuals and also serves to know and give added value to the biodiversity of the region. All individuals described below include a photograph, all photographs are my authorship.The original registration list is included in Appendix 1 section

Family: Anyphaenidae

These spiders are commonly found in homes, very docile. Those found have been of small size, no more than 1 cm in length. They have 8 eyes divided into 2 groups. The general characteristics of the individuals found are that they have thick hairs that look like thorns on the legs, their prosoma and abdomen are elongated, the abdomen more than the prosoma and their coloration goes in shades of brown with certain stripes and darker and lighter patterns, nothing flashy. No genera were identified.

Photography 1. Unidentified species of Anyphaenidae

Family: Araneidae

***Alpaida bicornuta* (Taczanowski, 1878)**

Alpaida sp are a species of spider distributed in South America. They have structures resembling two spines in the front part of the abdomen (hence the name bicornuta) and the posterior part ends in a spike. It has yellow coloration with orange-red stripes and striking patterns. Its prosoma is entirely red or very vivid orange. Its eyes are distributed in 3 groupings, 4 eyes in the center and one eye on each side. Being black, they stand out very much from their prosoma. Found in the agricultural area near Lita.

Photography 2. Alpaida bicornuta (Taczanowski, 1878)

***Araneus* sp.**

Garden Spider. They weave an orbicular web almost 30 cm in diameter, they can be found right next to their web, in a small shelter they use to hide from the sun and other environmental factors, in leaves of the same plant where they weave the web or they use fallen dry leaves or simply build the shelter entirely of silk. The shelter is cone-shaped, so they fold the leaves to create this funnel shape where they hide.

They have a circular abdomen, much larger in comparison to their prosoma and have two pairs of legs almost protruding from the shelter, these have orange coloration with black stripes and their abdomen is brown. Its close relative, *Araneus diadematus*, the European garden spider, is that spider, which had served as the first model for the study of the web as a biomaterial.

They are found both in city gardens and in the countryside where there is abundant vegetation and green grasses.

Photography 3. Araneus sp.

***Argiope argentata* (Fabricius, 1775)**

Fairly common spider in gardens and open fields throughout the region. Easy to identify by the shape of its abdomen which has 5 spike-like structures on the posterior part of the abdomen and its yellowish coloration from the middle of the abdomen towards the back. Its size varies from small individuals of 4mm to 13mm (male and female respectively). In addition, it is easily identifiable because it perches in the center of its web and joins its two front and hind legs on each side forming an "X", additionally it weaves in the middle of its web a stabilimenta or ornament that points to the center.

They can be found in gardens within the city as well as in fields ranging from pastures to dry forests; many prefer agaves for weaving their webs.

Photography 4. Argiope argentata (Fabricius, 1775)

***Cyrtophora citricola* (Forsskål, 1775)**

Sociable spider found in the dry forest of Urcuquí. It is approximately 1 cm long. They live in large communities and together create an immense web easily identifiably. Brownish in color, their abdomen has protuberances that resemble thorns.

They like to create their web on plants of the genus Agave and cacti, although they also do it on thorny trees. It is an atypical orb-weaver because, despite belonging to the family of orbicular web spiders, this species does not build its web in an orbicular shape, but creates a network of many spider webs that are joined together to create a huge web where many individuals can coexist.

Photography 5. Cyrtophora citricola (Forsskål, 1775)

***Eustala* sp.**

Humpbacked weaver spiders. This spider has a peculiar arrowhead shape. Its abdomen is widest at the front and forms a sort of cone towards the rear giving it an arrowhead shape. It also has patterns on the dorsum of the abdomen that follow this same tendency to point toward the posterior center of the abdomen. In addition, it surrounds its abdomen with the most posterior pair of legs highlighting this pointed shape. The individual found averages approximately 7 mm.

The individual was camouflaged in the bark of a tree covered with white-green lichen and the spider mimicked this same coloration and its ability to attach its legs to the body to be confused with another lichen. It was found near Lita.

Photography 6. Eustala sp.

***Gasteracantha cancriformis* (Linnaeus, 1758)**

A spider that varies from 2 mm to 10 mm. Many spiders with similar characteristics but with variations in color and abdomen shape are called by the same scientific name. This spider has an oval silhouette with longer ends on the sides. Its abdomen resembles a shield with up to six spines on the edges. Colors include white, yellow, or red combined with black.

They are usually found with the belly pointing towards the most exposed part of the web, in this area it has less coloration and is usually black but you can still distinguish the spines on the edges.

It was found in the Botanical Garden of Yachay Tech, near Lita and in the city of Ibarra, so it seems to be distributed throughout the province in open fields.

Photography 7. Gasteracantha cancriformis (Linnaeus, 1758)

***Mangora* sp.**

May be closely related to the genus *Epeira* (now *Araneus sp*.) (Pickard-Cambridge, 1889). Common in gardens and open fields full of grasses. It has a tomato-brown coloration with white patterns on the sides of the abdomen, on its legs it has very visible hairs without being exaggerated. Found in Lita's fields.

Photography 8. Mangora sp.

***Metepeira* sp.**

Spider that is very similar to the spiders of the genus *Araneus sp*., the clearest difference lies in its coloration, the tips of the legs are bright reddish-orange, its cephalothorax is more prominent than in *Araneus sp*. and is of dark coloration. Their abdomen presents a pattern of coloration in undulations in two lines, more separated in the initial part of the abdomen and they come together when approaching the rear part. They build a shelter using dry leaves or they can make it entirely of silk, but always in the form of a cone, suspended above their orbicular web, which they use to capture their prey. Approximately 1.5 cm in size. Found in gardens within the city.

Photography 9. Metepeira sp.

***Micrathena* sp.**

Spiny spider. Unlike the species *Gasteracantha cancriformis*, the shape of these spiders is more elongated, both the abdomen and the prosoma. They commonly have two spine-like structures that can be extremely long (up to twice their size), although they

may have more. They are brightly colored, including black, yellow, green, white, red, tomato. Individuals found near Lita, measure from 1mm to 5 mm approx.

Photography 10. Micrathena sp.

***Ocrepeira* sp.**

This spider was found in the botanical garden of Yachay, its body is covered with hairs that resemble velvet. It is half a centimeter long and its coloration is entirely brown with white tones and some black dots. Its abdomen resembles a shield, which has two points on the sides of the front.

Photography 11. Ocrepeira sp.

Family: Caponiidae

***Nops quito* Dupérré, 2014**

Species described for Ecuador in 2016. It differs from other spiders of the genus Nops by its patterns on the abdomen (Dupérré, 2014). The individual measured 1cm, 25 mm the prosoma and 75mm the abdomen, it looked very swollen so it was possibly a female ready to lay eggs. The prosoma was orange colored and its legs and abdomen were green with darker green patterns. It was found inside a home in the city of Atuntaqui.

Photography 12. Nops quito Dupérré, 2014

Family: Ctenidae

***cf. Ctenus* sp.**

Robust spider of about 3 cm approx. Brown coloration along its entire body with darker and lighter touches at the joints of the legs and on the abdomen. It was found on the trail near Lita, walking in the mud. Relative to the genus *Phoneutria sp.* so its venom

could have similar characteristics and therefore should be handled with care. Belonging to the superfamily Lycosoidea, it has 8 eyes.

Photography 13. Ctenus sp.

Family: Dipluridae

Two-tailed spiders, which are specialized organs for the manipulation of silk, create funnel webs that serve as shelters. Spiders belonging to the infraorder mygalomorphs, tarantulas.

Photography 14. Unidentified species of Dipluridae

***Linothele* sp.**

These individuals were found along the trail leading to the Conrayaro waterfall in Timbuyacu. Their size varied from smaller individuals of about 3 cm in length to others of 5 cm in length, they were easily found in the funnel-shaped webs, which were built in pieces of exposed soil as in the walls of a hill. Completely black to the naked eye, but with good illumination reddish and yellowish colors are visible on the cephalothorax. Two well-defined "tails" on the posterior part of its abdomen.

Photography 15. Linothele sp.

Family: Linyphiidae

Sheet-weaver spiders are spiders, mostly small in size, no larger than 1 cm. Some have shapes similar to individuals of the Theridiidae families or even to a mixture with the Anyphaenidae family. Their characteristic is that they weave extensive webs, resembling somewhat in structure to orbicular webs, however, they do not have a fixed pattern and can spread over a lot of vegetation. For this reason, they are known as sheet weavers, because their web is like an extensive blanket.

No genera were identified for this family and they were found in the transition zone between the most intact forest and the agricultural zones in both Timbuyacu and Lita.

Photography 16. Unidentified species of Linyphiidae

Family: Lycosidae

One of the most common and numerous families in the region, they are found in all the sites where samples were taken, however, they are also one of the most elusive, mainly because they are fast runners and do not depend on a web to get their food and for this reason, there is no photographic record of many of their species. Even so, they are undoubtedly present and abundant. Of the few that were photographed, no genera were identified.

Photography 17. Unidentified species of Lycosidae

Family: Pholcidae

Long-legged spiders, found inside homes in both Atuntaqui and Ibarra, are tiny in body size, only a few mm, however, their legs can reach a couple of cm in length, the largest found to be about 5cm. It is difficult to distinguish any characteristics other than their iconic disproportionate legs.

Photography 18. Unidentified species of Pholcidae

Family: Pisauridae

Evidence that there are more individuals of the Pisauridae family in the Lita region is evident in the abundance of spider webs on the ground, characteristic of this family, which are quite dense and reflect different shades of the light spectrum, probably because they trap small water droplets.

***Dolomedes* sp.**

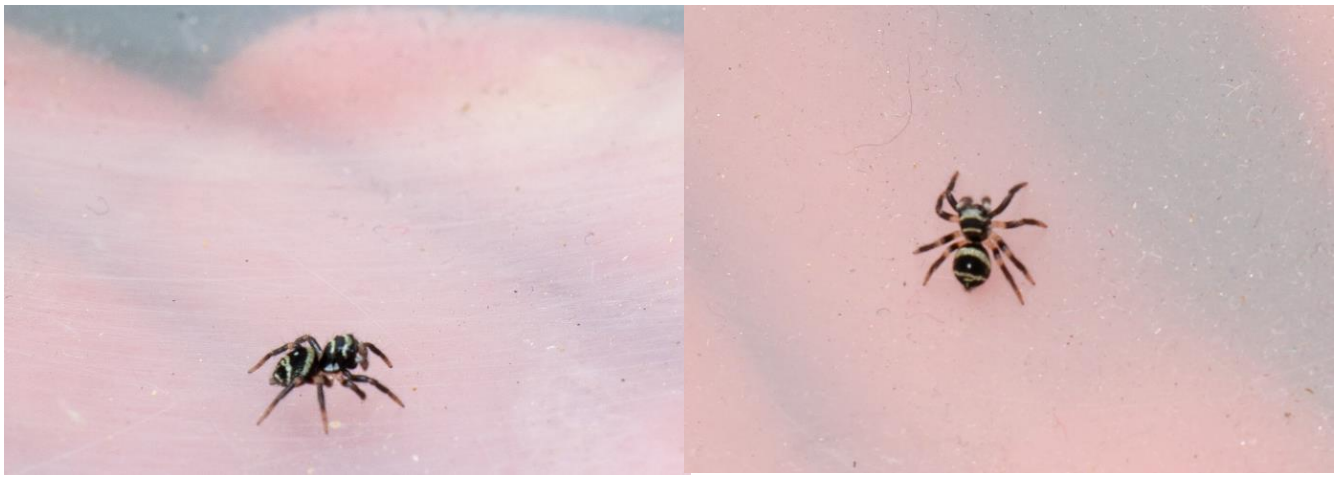
Dolomedes is a genus of large spiders, most of which are semi-aquatic and can be found near streams and rivers. The individual was found on a banana plant; although its size was not impressive, about 1.5cm, the color patterns and physical characteristics reveal that it belongs to this genus. It has a light brown coloration with white stripes on the sides, white dots on the dorsal part of the abdomen in two rows, and lighter colored stripes along the legs. Extended legs that they probably use to stay on the surface of the water.

Photography 19. Dolomedes sp.

Family: Salticidae

***Corythalia* sp.**

This small individual measures only 0.6cm in length and was found in a little disturbed area of Lita near an improvised road, identifiable to species level by its white patterns in several stripes and the rest of its body with a black coloration.



Photography 20. Corythalia sp.

***Frigga crocuta* (Taczanowski, 1878)**

This species can be identified by its coloration, which ranges from dark brown to lighter shades, it has three well-defined stripes of a lighter color or white, one in the center and one on each side that extends from its head and continues along the abdomen to the end of the body. This individual was one of the largest found in this family, measuring approximately 2 cm.

It was particularly fast, its movements of change of direction were almost imperceptible to the human eye, making its gait very attractive to watch. It was found in the botanical garden of Yachay.

Photography 21. Frigga crocuta (Taczanowski1878)

***Mexigonus?* sp.**

This is one of the most common spiders in homes, it has been constantly sighted in all types of buildings, homes, schools, offices, etc. The identification of this individual was not clear even though it is very common, the genus Mexigonus was the most visually similar, however, the identification does not match due to the distribution (only in Mexico). It is entirely brown and has small darker and lighter patterns, about 5 mm in length.

Photography 22. Mexigonus ? sp.

Family: Sicariidae

***Loxosceles* sp.**

Fairly common and abundant. Easy to find in urban environments, in neglected places indoors. It measures about 1.5 cm only the body and more than double if we count the extension of the legs. Like all Loxosceles species, it is recognizable by its "pear-shaped" cephalothorax and distinctive violin-shaped spot, hence they are known as violin spiders. The species encountered is dark brown in coloration. The male is smaller than the female. This spider lives in neglected corners of the home and produces very fine spider silk. Its method of catching prey is through active hunting. In addition, its venom is very potent and it is recognized as a spider of medical importance. During the study, anecdotes of bites by this spider with clinical conditions corresponding to **loxoscelism** were reported.

Photography 23. Loxosceles sp.

Family: Tetragnathidae

Photography 24. Unidentified species of Tetragnathidae

***Leucauge* sp.**

An abundant species in the province, they were found in almost all the locations visited and in large numbers. White-striped frog spiders have an elongated opisthosoma with thin black, yellow, white and orange striped coloration. It creates an orbicular web, although it does not belong to the orbicular web spider family, Araneae. Thin and little more than 1 cm in length, doubling the size by counting the legs. Individuals live not together, but very close together; where one of these individuals is found, it is very likely to find a few more in the vicinity.

Photography 25. Leucauge sp.

Family: Theridiidae

***Anelosimus* sp.**

The second species of social spider found in this work. Located in the Yachay botanical garden, it shares habitat with *Cyrtophora citricola*. This species is different from *Cyrtophora citrícola* because it does not create a web with an orbicular structure, but it does it randomly and mainly covers thorn trees. It is small and no more than 2 cm in size, identifiable by its shape, shared with other members of the Theridiidae family and because its legs have black bands, and the general pigmentation of its legs is yellowish. Its body has shades ranging from green to red to yellow.

Photography 26. Anelosimus sp.

***Latrodectus geometricus* C. L. Koch, 1841**

Brown widow, a close relative of the famous black widow, recently reported in Ecuador and confirming the presence of *L. geometricus* in the province of Imbabura, distribution suggested by Roberto Kalsin in his graduate thesis (Kaslin Ulloa, 2013). The female of this spider species measures about 1 cm (body) and has several characteristics that make it easy to identify. The coloration of the dorsal part of its abdomen is brown, with a circular pattern that includes an outer black stripe, a white stripe, a yellow stripe and the lateral patterns are also influenced by a black spot resembling an "eye". On the ventral part of its abdomen, it has the characteristic red hourglass and its egg sac has a particular "star" shape, it is circular with many spikes around it, measuring about 8 mm. This species seems to live without problems in small spaces with other members of the same species, about 5 individuals were found living in the same 2 x 2 m wall. The second

spider species of medical importance described in this research, its venom is the same as that of the black widow, but it is believed that it injects it in smaller quantities, so it is not lethal. It was found inside homes in Atuntaqui.

Photography 27. Latrodectus geometricus C. L. Koch, 1841

***Parasteatoda* sp.**

Common house spider, brown with lighter and darker shades. Its size does not exceed 1 cm in length. It could be confused with the brown widow, however, it does not have defined patterns in its coloration. It builds its web in corners of porches or corners of walls and usually, more than one is found in the same web, possibly being its offspring.

Photography 28. Parasteatoda sp.

***Steatoda grossa* (C. L. Koch, 1841)**

Also known as false black widow. It is confused with the black widow because of its dark coloration and similar shape and size (like most Theridiidae). This spider is very common in homes, is found in corners and places with little traffic and can generate a large progeny and are very invasive and can become a pest. It has a dark reddish-brown coloration with white patterns on the back, similar to arrows pointing to its prosoma, they have a white stripe forming a semicircle in the most frontal part of the abdomen and the prosoma is brown or black, males and females are quite similar but the male is a little smaller and thinner.

They can live in large communities, without being sociable spiders. About 20 individuals were found in a corner of an attic with a surface of about 1 x 1 m in Atuntaqui.

Photography 29. Steatoda grossa (C. L. Koch, 1841)

Family: Trechaleidae

***Trechalea* sp.**

A spider that lives near rivers where it hunts for food, lives in small burrows and seems to always be found with its legs extended, just like the *Trechalea extensa* of Mexico. Its coloration is brown, both prosoma and legs have the same color tone with just a few darker parts at the joints of the legs. It has hairs on the sides of the prosoma, abdomen, legs and pedipalps that can be brown, black or white. In its abdomen, it presents

a mixture of brown colors like the prosoma, lighter brown, black and white. The shape of its prosoma is circular from behind its ocular structures, which is black, to the junction with the abdomen. Its abdomen is the same size as the prosoma, oval with a small protrusion towards the final tip. Its body measures about 4 cm in total, but its extended legs reach a wingspan of almost 20 cm and also have well-defined white or black spines. It is quite intimidating. Apparently, this species lives with a pair, although it is not certain that it is a case of monogamy. Both individuals inhabit the same burrow, guarding their egg sac, which, from the dorsal view, is black with a white stripe on the outside, in fact, the entire ventral part is white. Found on a small slope of the Mira River, where there was not much water depth, its presence was intuited since there was spider webbing on the rocks in the middle of the river.

Photography 30. Trechalea sp.

The identification of individuals, in some cases, could be made down to the genus level in many cases, because general distinctive characteristics of the different species were used. However, a deeper bibliographic, anatomical and genetic analysis is recommended for the accurate identification of individuals and the possible identification of new species for Ecuador and the world.

4.2. Descriptive statistics on taxa diversity and abundance

Obtained data in the field

The following table shows, by marking with an "x", the families found at each sample collection site and the total number of families for each site. This type of analysis was performed in order to leave aside the number of individuals found for each family at each site. Later on, the number of observations is included even if the individuals belong to the same family to make the statistical analysis of abundance and diversity.

Table 2. Frequencies for each location

	Antonio Ante	**Lita**	**Pimampiro**	**Timbuyacu**	**YT Botanical Garden**	**Zuleta**
Anyphaenidae	x					
Araneidae	x	x	x	x	x	x
Caponiidae	x					
Ctenidae		x				
Dipluridae			x	x		
Linyphiidae		x		x		
Lycosidae		x		x		
Pholcidae	x					
Pisauridae		x				
Salticidae	x	x			x	
Sicariidae	x					
Tetragnathidae		x		x	x	
Theridiidae	x				x	
Trechaleidae		x				
# OF FAMILIES	7	8	2	5	4	1

In addition, from the complete list of species that were recorded, the total number of families and genera identified for the province of Imbabura was calculated.

Total # of Families	14
Total # of Genera	22

The above table indicates that, concerning families, the region of Lita is the most diverse, and maybe because it is located on the border with the provinces of Esmeraldas and Carchi and therefore the habitat is very varied, although, with a tendency to be a tropical forest, it may harbor a greater diversity of species. In second place is the canton of Antonio Ante, which also has a great variety of families above places like the area of Timbuyaco or the YT Botanical Garden.

What is important to note here is that the fauna found in places far from the cities is that there are families of arachnids that are larger, more robust and with a tendency to actively hunt for food. It is possible that, for this same reason, spiders are more elusive and therefore it has not been possible to record more species in forest regions.

The families recorded during the study are shown below, in addition to those obtained from the iNaturalist database, for which relative abundances were calculated in percentages and for the latter, diversity indices were calculated.

Normally when a family is repeated, that is, the observation belongs to the same family, the observation is carried out by a different person or the observations are sufficiently separated, in distance terms, to be counted as distinct, it is also because visually distinct individuals were chosen, which were later determined to belong to different genera, but the same family. This is because during the investigation in the field, there were individuals that possibly appeared in terms of offspring (parents and offspring)

that reached a colony of twenty or fifty individuals and in that case they were counted as only one observation, otherwise the data would have been very inaccurate.

These same data from Figure 6 are shown in the table below in numbers. According to the data obtained, the Araneidae family is the most abundant, followed by the Theridiidae, with about half as many records as the first, then there are the Tetragnathidae, Salticidae, Linhyphidae and Lycositade which, compared to the Araneidae family, we would assume are not very abundant, however, this is discussed in the next section. We further take these families into account for comparison with the families found by iNaturalist users in the past three years (2019-2021).

Table 3. Relative abundance (%) of each family

Anyphaenidae	**2%**
Araneidae	34%
Caponiidae	2%
Ctenidae	2%
Dipluridae	4%
Linyphiidae	8%
Lycosidae	6%
Pholcidae	2%
Pisauridae	2%
Salticidae	8%
Sicariidae	4%
Tetragnathidae	8%
Theridiidae	16%
Trechaleidae	2%

Data obtained from the database

The data from the iNaturalist database are presented below and were used for the statistical analyses, as they are a sample of the largest population with about 550 total observations.

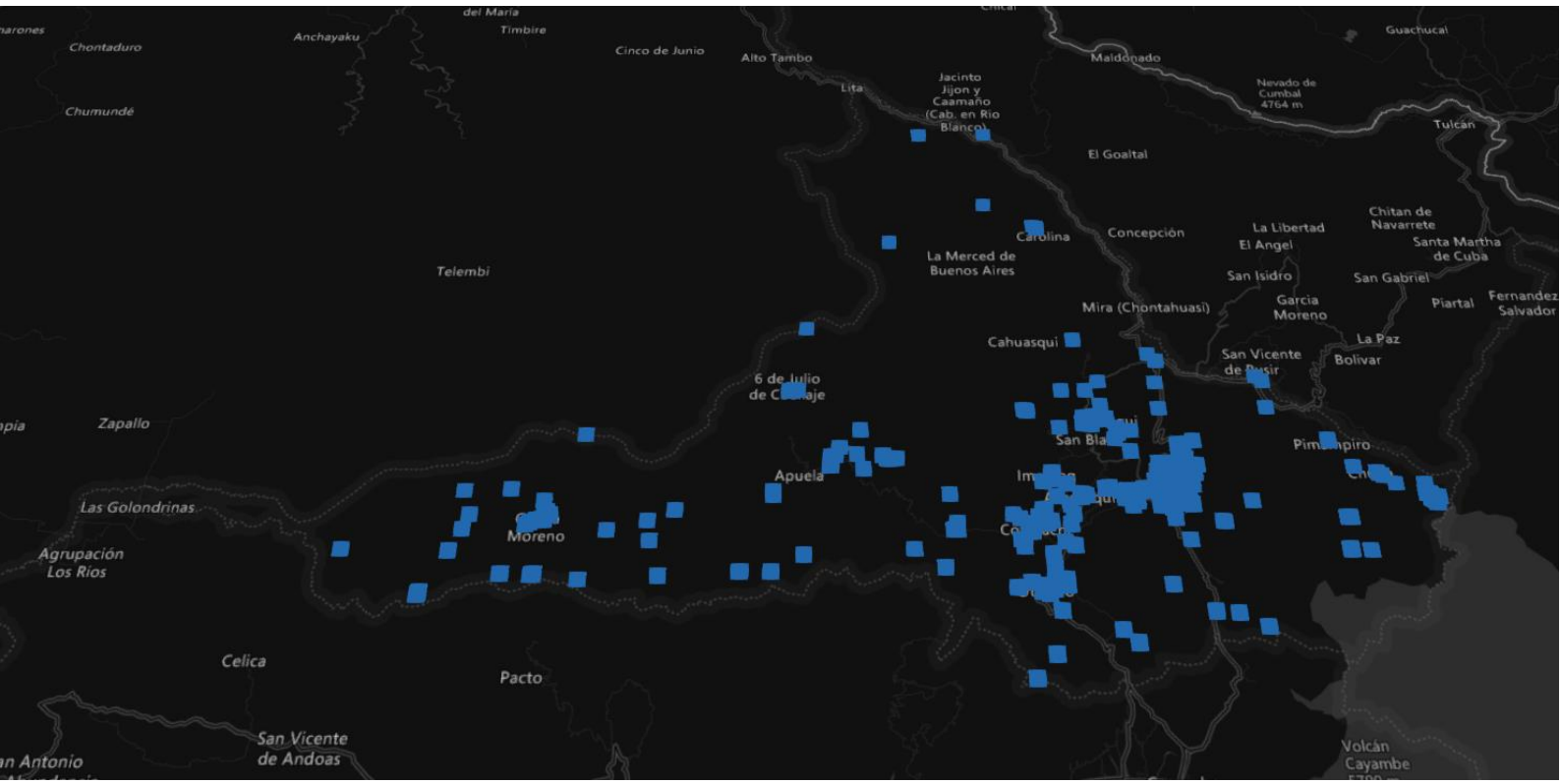


Figure 7. Available records used as background information in order to plan this study sampling strategy

All the geographically registered sites from which data were captured and then uploaded to the iNaturalist platform are shown.

Unlike the data obtained during the field work, the distribution of the sample collection points covers a larger area of the province so it is more efficient to find all the families of aranas that can be found in the area; although most of the samples collected are located near the cities such as Otavalo, Cotacachi, Atuntaqui, Urcuquí and Ibarra.

The number of total families registered by iNaturalist users gives us a broader picture of all the diversity that can be found in the province, listed in Table 5, some of the families registered contain at least 1 observation, which does not make them suitable for accurate statistics.

Table 4. Relative abundance (%) of each family, according to iNaturalist records available before this study's sampling effort

Agelenidae	**0,360%**
Anyphaenidae	3,963%
Araneidae	44,504%
Caponiidae	0,360%
Clubionidae	0,180%
Corinnidae	0,360%
Ctenidae	1,441%
Desidae	0,180%
Dipluridae	1,081%
Filistatidae	0,180%
Hersiliidae	0,180%
Linyphiidae	1,261%
Lycosidae	8,468%
Oxyopidae	0,180%
Pholcidae	1,261%
Pisauridae	0,360%
Salticidae	7,387%
Scytodidae	0,180%
Selenopidae	1,081%
Sicariidae	1,441%
Sparassidae	0,180%
Tetragnathidae	8,288%
Theraphosidae	6,30630631
Theridiidae	6,12612613
Thomisidae	2,34234234
Trechaleidae	2,34234234

The total number of families amounts to 26, the total number of families worldwide is 108. This means that in the province of Imbabura can be found up to 28% of the families worldwide, a very high rate considering that these are data from a single province of Ecuador.

The most abundant families according to these data are the families Anyphaenidae, Araneidae, Lycosidae, Salticidae, Tetragnathidae, Theraphosidae, Theridiidae, Thomisidae and Trechaelidae. These will then be used to create potential distribution maps with the help of MaxEnt software.

Then, Simpson and Shannon's indices were calculated to measure the wealth of families.

Simpson diversity index:	Shannon diversity index:
0,7710	3,0421

Simpson's index, being closer to the value 1, indicates that one family is dominant, the Araneidae family, and the overall diversity could be low.

In both cases, the data obtained in the field and those obtained from the database coincide in that the Araneidae family is, by far, the most abundant. This may be due to factors that will be discussed in the next section.

The data can be biased by the habitat where some individuals of a certain species are more abundant than others (Fithian et al., 2015), so in the samples taken we filtered and discarded the number of individuals of a family if it was repeated in the same site of extraction of the samples.

Conducting research of this nature can help to obtain, promote and add value to titles such as Imbabura, a UNESCO Global Geopark. It serves for the inclusion of educational books and awareness of the population.

The statistical analysis of biodiversity and abundance indicates that there is a dominance of one family occupying most of the observations, in fact, both in the iNaturalist database data and in the samples obtained in the field indicate that the most

dominant family is Araneidae. However, this data could be biased because this family would be the easiest to find and identify since it is the one that creates orbicular webs, which are showy as opposed to other spider families that can be more discrete.

From the data obtained in the field and through the database, there is a clear similarity in terms of the most abundant families or the easiest to find: Araneidae, Lycosidae, Theridiidae, Salticidae and Tetragnathidae. This is also related to the fact that the first 4 families mentioned are the families with the highest number of species in the spider order worldwide.

Creating social webs seems to be an advantage in the dry forest of the Chota valley since, apart from finding and describing 2 species of social spiders, there are spiders of the family Theridiidae that occupy intermediate webs created by *Cyrtophora citricola* and are also found in large numbers, in this study they could not be identified because of their size and little distinctive coloration, entirely black and a few millimeters in length. In addition, spiders such as *Argiope argentata*, although they do not create a web, do occupy a large proportion of an *Agave*, with up to 5 individuals surrounding the plant.

When 2 of the 4 genera of spiders of medical importance (*Loxosceles* and *Latrodectus*) were found in urban sectors, in homes. A consultation was made at the Hospital San Vicente de Paul, to access the records and verify how many cases of spider bites were recorded during the period 2020-2021, which coincided with the quarantine period due to Covid-19. Given that people were forced to stay indoors, it could have increased the chances of an accident with a spider of these genera. However, no case was found for which it was diagnosed as a spider bite. This means that, despite the probabilities, a bite is extremely rare, suggesting that spiders are not dangerous when they do not encounter humans as possible prey. Moreover, with the experience gained in this research, it is known that spiders of these genera are very shy and prefer to flee when encountering something beyond their capabilities. What is recommended is to maintain good housekeeping habits so that these individuals proliferate and in case one is found, it is best to relocate, with the necessary precautionary care.

5: Conclusions

This chapter lists the conclusions drawn from this thesis work.

An enormous step was taken in the registration of the diversity of spiders in the province, there are 26 or more families of spiders in the province of Imbabura alone.

Through a photographic record and nautical history, the knowledge about the biodiversity of the province has increased and, being registered as a geopark and UNESCO heritage site, it can promote the conservation of habitats and animal species.

The Araneidae family is the most abundant and the easiest to find in the province. Followed by those families with the largest number of species in the order of spiders, Lycosidae, Theridiidae, Salticidae.

The families found during the research correspond in terms of abundance with those downloaded from the iNaturalist database.

The climate in a single province seems to be very specific compared to the rest of Ecuador.

Creating social webs seems to be an advantage in the dry forest of the Chota Valley.

Medically important household spiders do NOT represent a danger to humans.

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Appendix

A.1. List of all individuals found during the research

city	scientific_name	taxon_family_name	taxon_genus_name	common_name
Antonio Ante	Anyphaenidae	Anyphaenidae		Arañas fantasma
Antonio Ante	Araneus	Araneidae	Araneus	arañas de jardin y de granero
Antonio Ante	Araneus	Araneidae	Araneus	
Antonio Ante	Araneae	Araneidae		Arañas
Antonio Ante	Nops quito	Caponiidae	Nops	
Antonio Ante	Pholcidae	Pholcidae		Arañas patonas
Antonio Ante	Mexigonus	Salticidae	Mexigonus	Arañas saltarinas
Antonio Ante	Loxosceles	Sicariidae	Loxosceles	Arañas violinistas
Antonio Ante	Loxosceles lutea	Sicariidae	Loxosceles	
Antonio Ante	Latrodectus geometricus	Theridiidae	Latrodectus	Viuda cafe
Antonio Ante	Latrodectus geometricus	Theridiidae	Latrodectus	Viuda cafe
Antonio Ante	Steatoda	Theridiidae	Steatoda	Falsas Viudas Negras
Antonio Ante	Steatoda grossa	Theridiidae	Steatoda	Falsa Viuda Negra
Lita	Alpaida bicornuta	Araneidae	Alpaida	
Lita	Eustala	Araneidae	Eustala	Arañas tejedoras jorobadas

Lita	Gasteracantha cancriformis	Araneidae	Gasteracantha	Araña tejedora espinosa
Lita	Mangora	Araneidae	Mangora	
Lita	Micrathena	Araneidae	Micrathena	Arañas espinosas
Lita	Micrathena	Araneidae	Micrathena	Arañas espinosas
Lita	Ctenus	Ctenidae	Ctenus	Arañas vagabundas
Lita	Linyphiidae	Linyphiidae		Arañas tejedoras de sabanas
Lita	Linyphiidae	Linyphiidae		Arañas tejedoras de sabanas
Lita	Linyphiidae	Linyphiidae		Arañas tejedoras de sabanas
Lita	Lycosidae	Lycosidae		Arañas lobo
Lita	Lycosidae	Lycosidae		Arañas lobo
Lita	Dolomedes	Pisauridae	Dolomedes	Arañas pescadoras
Lita	Corythalia	Salticidae	Corythalia	Arañas saltarinas
Lita	Leucauge	Tetragnathidae	Leucauge	Arañas de rayas blancas
Lita	Tetragnathidae	Tetragnathidae		Arañas tejedoras de cuerpo alargado
Lita	Trechaleidae	Trechaleidae		Arañas pescadoras de patas largas
Pimampiro	Argiope argentata	Araneidae	Argiope	Araña plateada de jardin
Pimampiro	Dipluridae	Dipluridae		Arañas de dos colas
Timbuyacu	Araneus horizonte	Araneidae	Araneus	
Timbuyacu	Linothele	Dipluridae	Linothele	
Timbuyacu	Linyphiidae	Linyphiidae		Arañas tejedoras de sabanas
Timbuyacu	Lycosidae	Lycosidae		Arañas lobo
Timbuyacu	Tetragnathidae	Tetragnathidae		Arañas tejedoras de cuerpo alargado
YT Botanical Garden	Cyrtophora citricola	Araneidae	Cyrtophora	Araña Parda del Mediterraneo

YT Botanical Garden	Gasteracantha cancriformis	Araneidae	Gasteracantha	Araña tejedora espinosa
YT Botanical Garden	Araneidae	Araneidae		
YT Botanical Garden	Ocrepeira	Araneidae	Ocrepeira	
YT Botanical Garden	Argiope	Araneidae	Argiope	
YT Botanical Garden	Frigga crocuta	Salticidae	Frigga	
YT Botanical Garden	Frigga crocuta	Salticidae	Frigga	
YT Botanical Garden	Leucauge	Tetragnathidae	Leucauge	Arañas de rayas blancas
YT Botanical Garden	Parasteatoda tepidariorum	Theridiidae	Parasteatoda	Araña casera comun
YT Botanical Garden	Theridiidae	Theridiidae		Arañas de telaraña irregular
YT Botanical Garden	Theridiidae	Theridiidae		Arañas de telaraña irregular
YT Botanical Garden	Anelosimus	Theridiidae	Anelosimus	Aranas sociales de tela irregular

Zuleta	Araneidae	Araneidae	Arañas de telas orbiculares

A.2. Distribution of species in MaxEnt

The MaxEnt program uses an algorithm to determine the most probable distribution of a species in a geographic area, using geographic position information, which, together with photographs taken in situ, geographic position data (latitude and longitude) was collected for each of the individuals. It also uses data from a geographic site, together with environmental variables. In this case, the environmental variables are obtained from websites that collect meteorological information and were downloaded from the WorldClim website (https://www.worldclim.org/) and the climatic variables that were used in this study are summarized in the following table:

A2. 1. Climatological variables used in MaxEnt program.

variable
minimum temperature (°C)
maximum temperature (°C)
average temperature (°C)
precipitation (mm)
solar radiation (kJ m^{-2} day^{-1})
wind speed (m s^{-1})
water vapor pressure (kPa)

These data are downloaded with a resolution of 1km2, the maximum allowed on the website. Additionally, these data contain the information of the entire planet so first a cut of these layers must be made for the Ecuadorian territory and this was achieved thanks to the ArcGis program, ArcMap.

As the data obtained in this work were from 50 different individuals, the distribution information could be inaccurate, so, we downloaded from the iNaturalist

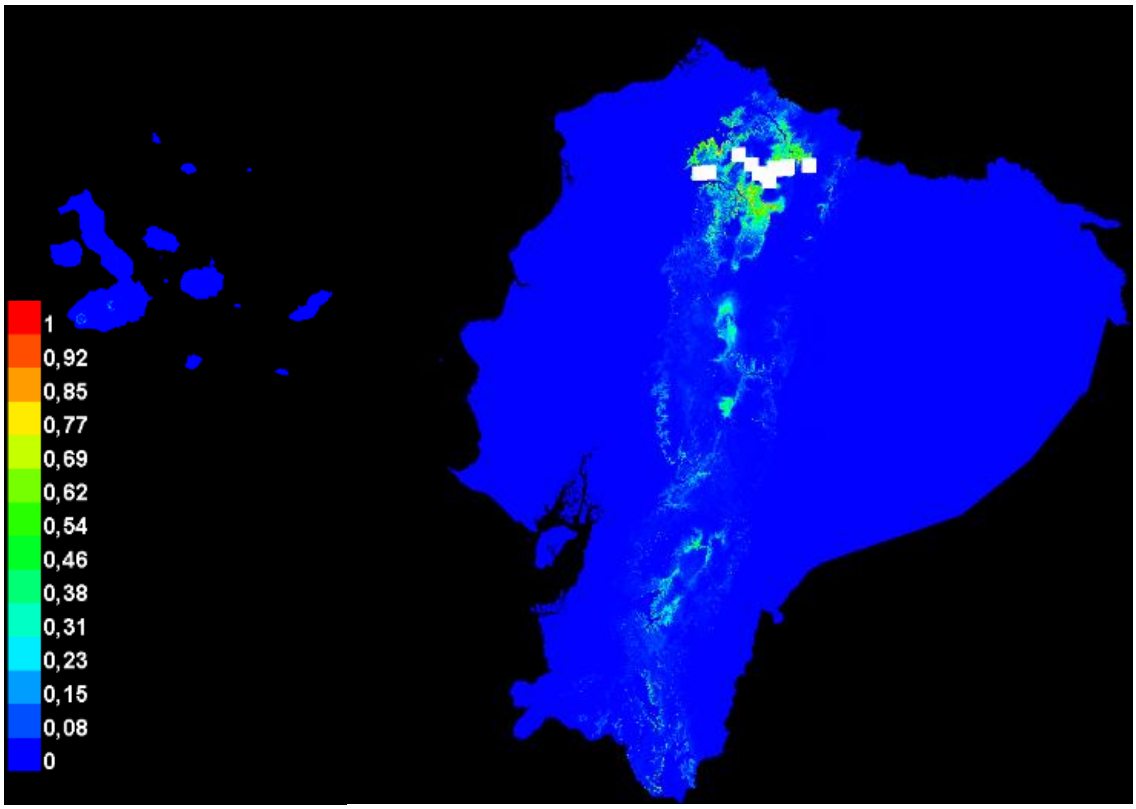
database all the observations for any spider family that has been identified during the last 3 years (2019-2021), obtaining a total of 550 observations with their respective geographical position data and, on which a distribution map is made in MaxEnt.

A statistical analysis of diversity and richness indexes including the Margalef index, Menhinick index, Simpson index, and Shannon-Wiener index is performed on these same data ("ESTIMACIÓN DE LA DIVERSIDAD ESPECÍFICA," 2014).

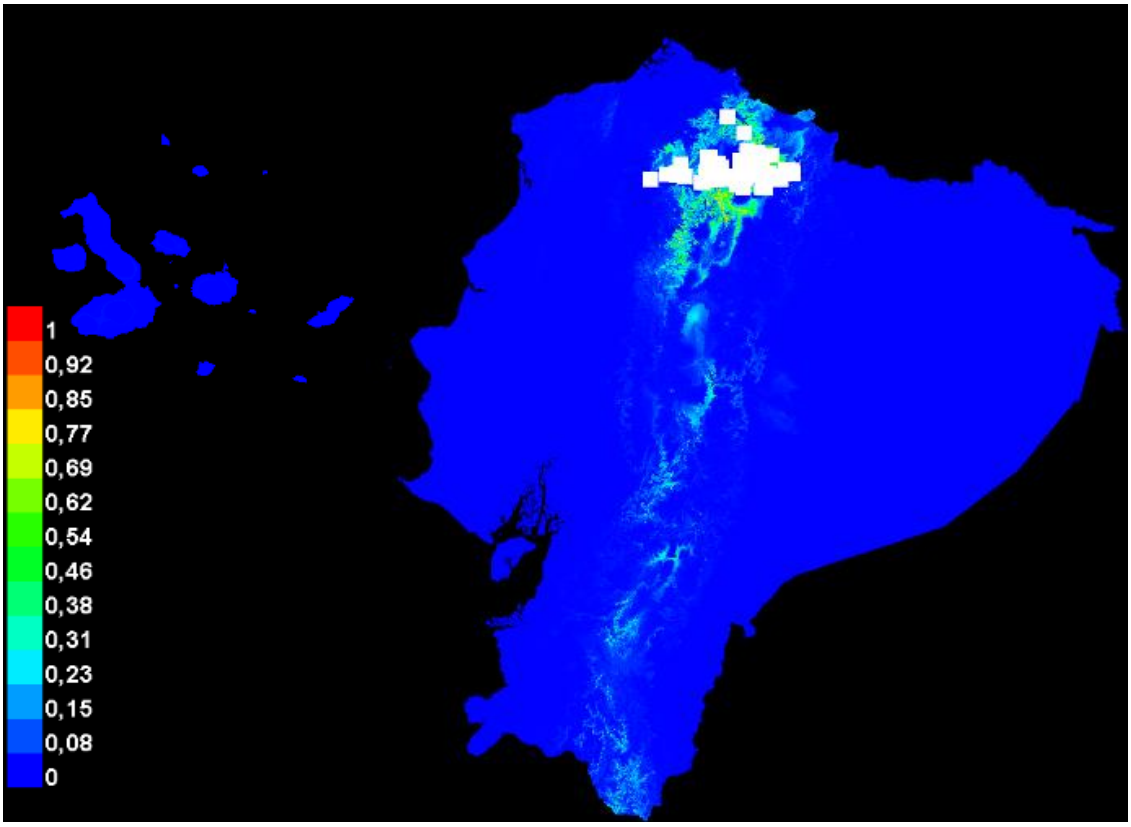
Finally, the data obtained from the database and the data obtained in the field were compared to identify a pattern in the distribution of species in the province of Imbabura.

A.2.1. Maxent development of 9 most abundant species

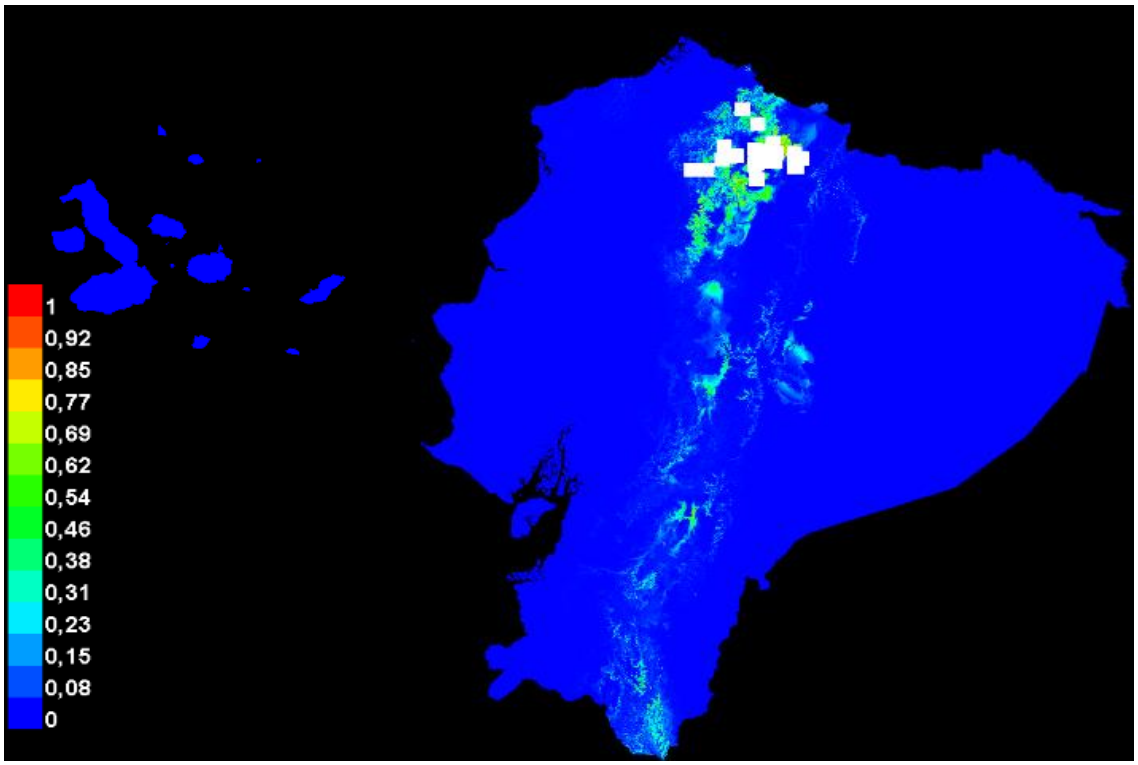
Based on the relative abundance previously represented in tables, the 9 most abundant families were selected, which include, Anyphaenidae, Araneidae, Lycosidae, Salticidae, Tetragnathidae, Theraphosidae, Theridiidae, Thomisidae y Trechaelidae. These families were chosen because the rest represent a very low abundance or the observations are less than 10 and therefore the distribution maps would be very inaccurate.



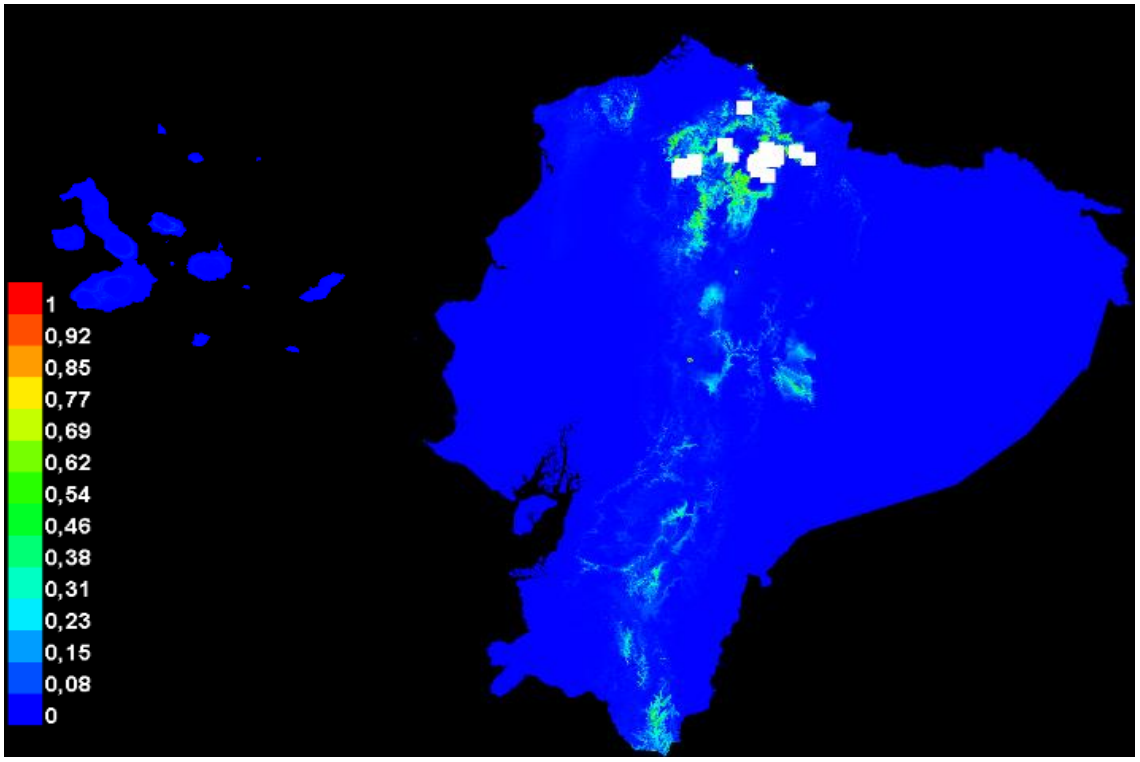
Ai.1. Distribution map for Anyphaenida



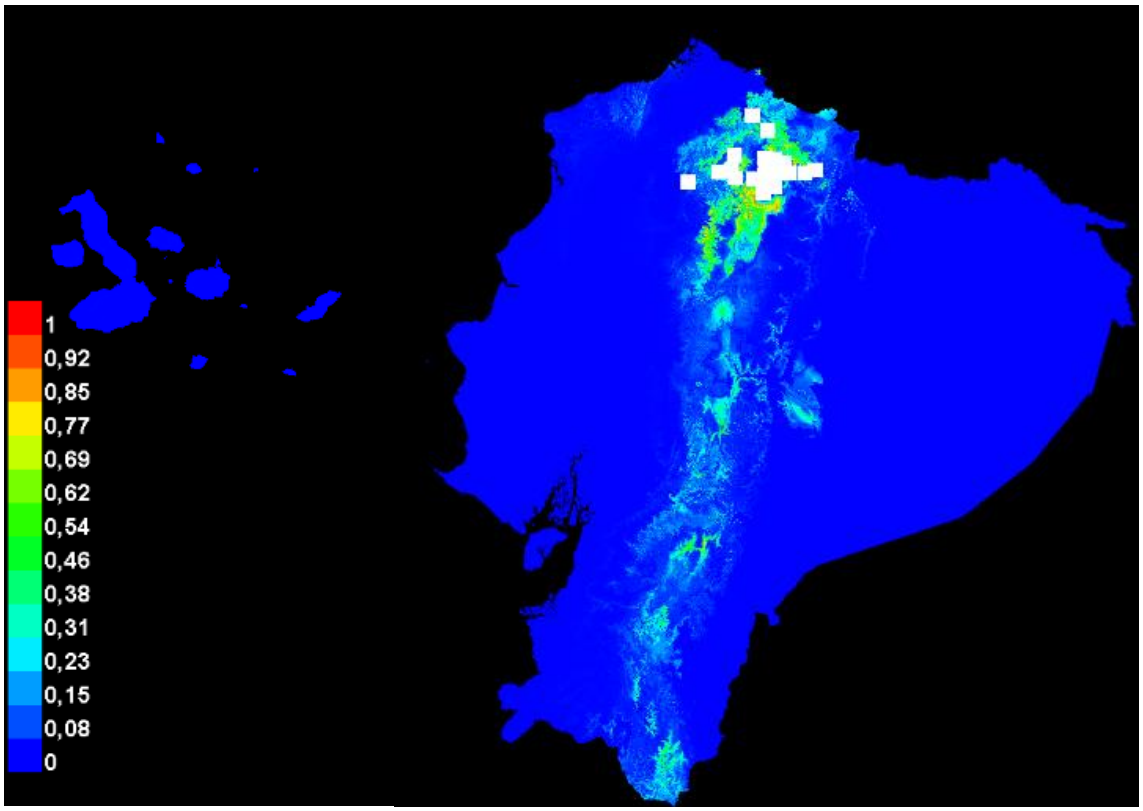
Ai.2. Distribution map for Araneidae



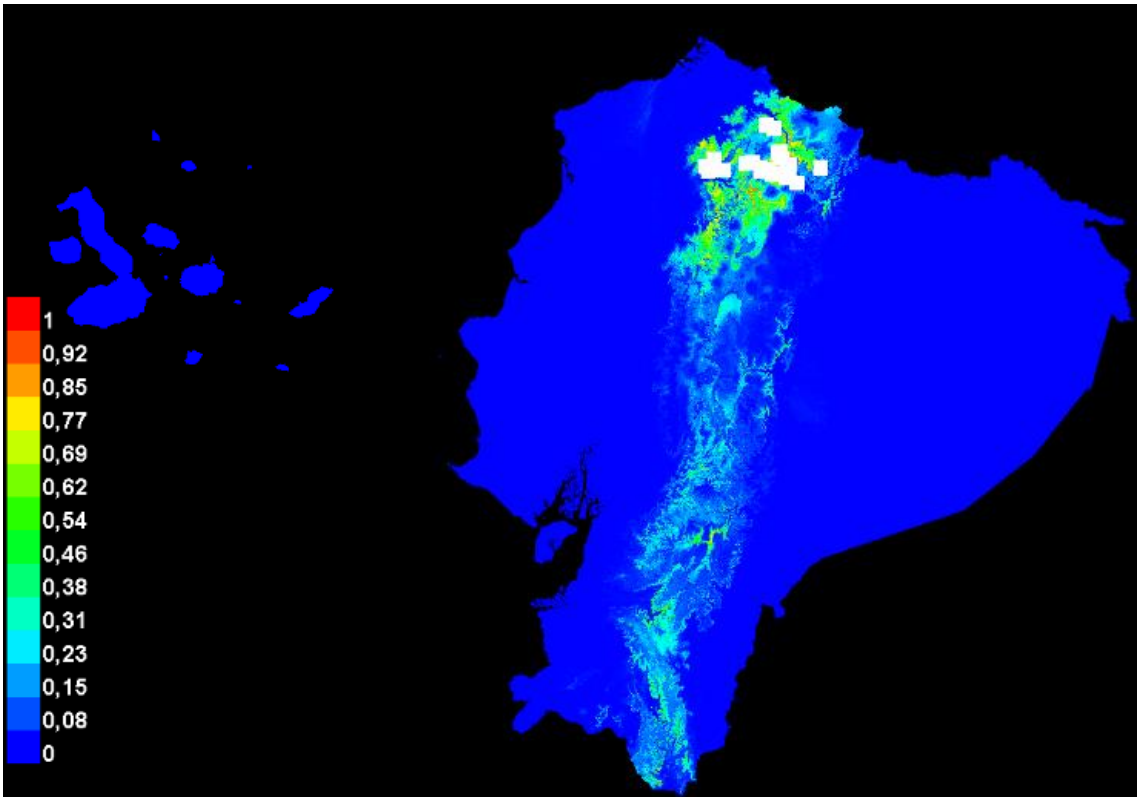
Ai.3. Distribution map for Lycosidae



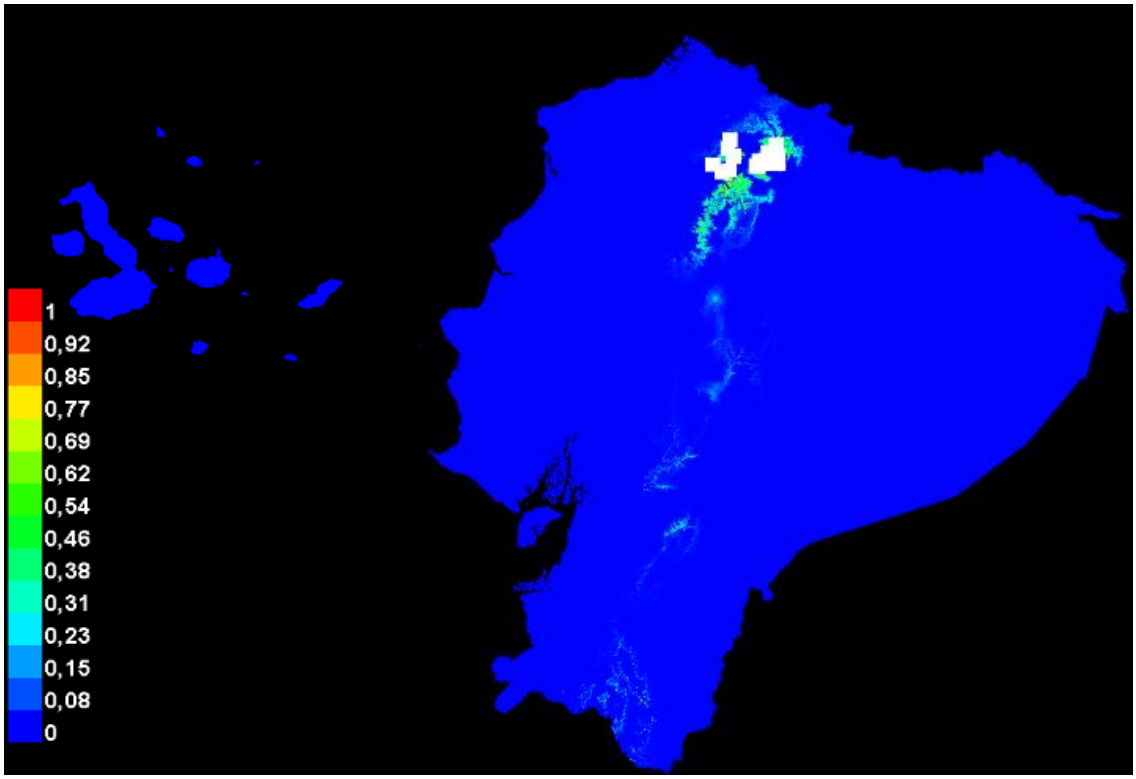
Ai.4. Distribution map for Salticidae



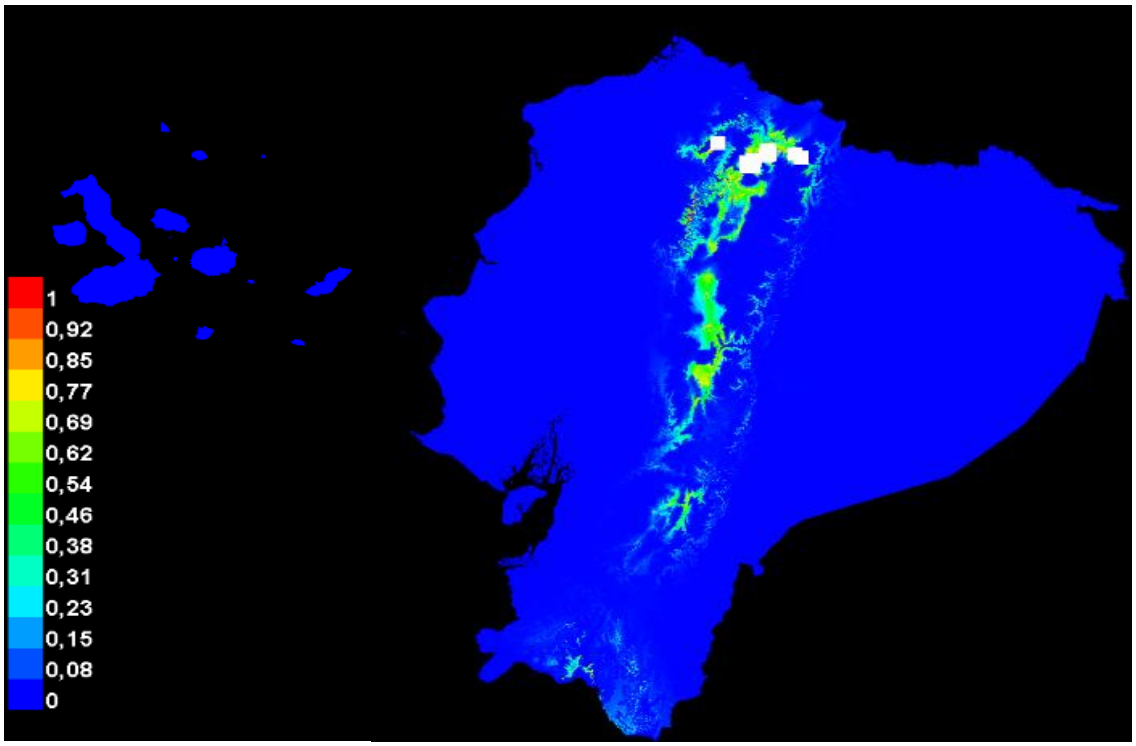
Ai.5. Distribution map for Tetragnathidae



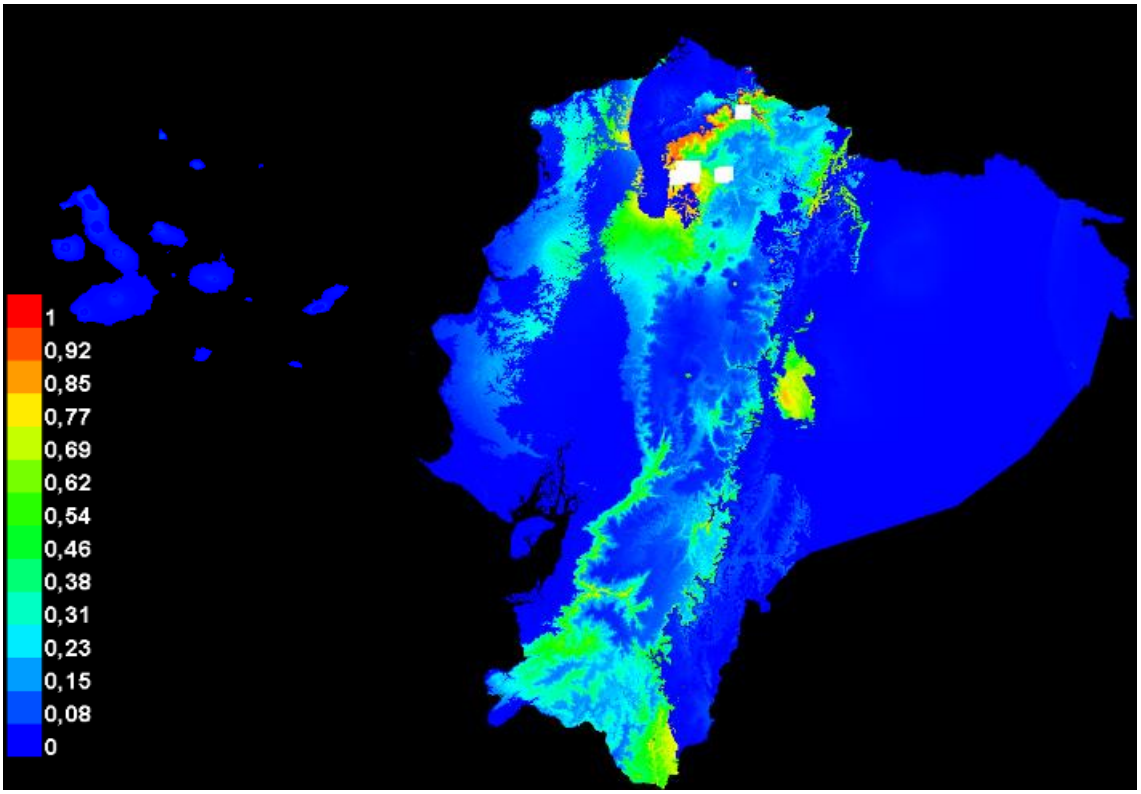
Ai.6. Distribution map for Theraphosidae



Ai.7. Distribution map for Theridiidae



Ai.8. Distribution map for Thomisidae



Ai.9. Distribution map for Trechaleidae

The majority of distribution maps obtained after running the MaxEnt program show that the species found in the province of Imbabura extend throughout the Ecuadorian highlands, the only exception is indicated in the case of the Trechaleidae family, which may be because these are found in more tropical areas, on the border with Emeralds and the tropical forest in the northern part of the province of Pichincha, the climatic conditions of a tropical environment seem to be repeated in certain parts of the Amazon.

When making the distribution maps through the MaxEnt program, plots are obtained that indicate that the distribution of most of the families analyzed could be found throughout the Ecuadorian highlands. However, it is suggested that more geographic distribution data is needed to be obtained because, by increasing the variability of the environments in which it is possible to find certain families of spiders, the distribution maps created by computer models will be more accurate and will serve to conduct and facilitate future research in this area. The climatologic conditions in the province of Imbabura seem to be very specific and for that reason, the distribution maps only show that it is possible to find these families along the highlands.

More studies of diversity in Arachnids are needed to generate new distribution maps, more accurate statistical analysis and more accurate knowledge of the real diversity of spiders in the province. more likely, because