

Botanical composition of Fabaceae family in the Brazilian Northeast, Maranhão, Brazil

ABSTRACT

Fabaceae is one of the most diverse families in the world, recognized for its ecological and economic potential; divided into six subfamilies (Caesalpinioideae, Cercidoideae, Detarioideae, Dialioideae, Duparquetioideae) In Brazil, it is the largest botanical family found in all the ecosystems (Amazon Forest, Caatinga, Cerrado, Atlantic Forest, Pantanal and Pampa). **The Present investigation identified 22 species, distributed in 14 genera and four subfamilies. *Mimosa* was the most representative genus, with five species, followed by *Bauhinia* with three and *Aeschynomene* with two, as to the habit, and 12 species are considered shrubs. The composition of the floristic list were presented, that help in understanding of plant species present in ecosystems investigated and filling gaps in biodiversity in the Brazilian Northeast.**

Keywords: Bauhinia, Cerrado, Leguminosae.

1. INTRODUCTION

Fabaceae is the most diverse plant family in the world [1] with a wide distribution of species, registering 770 genera and 19,500 species [2], considered the third largest family of angiosperms in species numbers after Asteraceae and Orchidaceae in the world context [2]. **In Brazil, are recognized 2848 species (1539 endemic) and 222 genera [3].** The family is circumscribed in six subfamilies: Caesalpinioideae (146 genera and 4400 species); Cercidoideae (12 genera and 335 species); Detarioideae (84 genera and 760 species); Dialioideae (17 genera and 85 species); Duparquetioideae (1 genus and 1 specie) and Papilionoideae (503 genera and 14000 species) with the inclusion of the groups of the previous subfamily Mimosoideae now in the subfamily Caesalpinioideae [2].

The **family** have economic importance, by having food crops that provide highly nutritious sources of protein and micronutrients that can benefit health and livelihoods, particularly in **the** developing countries [4, 5] and **have** ecological importance **too** because they are well adapted organisms to the first colonization and exploration of several environments, adaptations caused by their association with nitrogen fixing bacteria or with ectomycorrhizal [6]. The family have association with bacterium of the genus *Rhizobium* located in root nodules found in many species of Fabaceae, **converting** atmospheric nitrogen into ammonia, a soluble form that can be used by other plants, resulting in extremely valuable species as suppliers of natural fertilizers, in addition to their considerable importance in agriculture, **representing** their **ability** to occupy different habitats and diverse life forms [7,8,5].

In Brazil, Fabaceae **predominates** in the ecosystems **of** Amazon forest, Caatinga, Cerrado, Atlantic forest, Pantanal e Pampa [7,2]. In the phytogeographic domain Cerrado, the distribution of the family is very broad, being considered a global biodiversity hotspot, **accounting for 43% of surface water in Brazil [9].** Currently, global demand for ecosystem restoration has increased significantly in recent years, mainly by integrating ecological restoration to key international policies directly linked to biodiversity [10,11]. The **need** for

conservation and appreciation of tropical grasslands and savannas in the world has been increasing and becoming a cause for concern [12,13,14].

The state of Maranhão presents a strong predominance of Cerrado areas, where knowledge about Fabaceae presents several gaps mainly related to biodiversity records verifying the need for management and conservation of the family species since the Cerrado phytogeographic domain is subject to strong anthropogenic pressures.

The knowledge and registration of biodiversity provides support for future research of the most diverse nature, clarifying the doubts about the nomenclature of the species with the potential to increase the knowledge of occurrences of new groups. Works as this are important in obtaining data on the unknown species for the area of study. This can be verified in works such as of the [15] which recently recorded new occurrences of species of Papilionoideae to the state of Maranhão.

The objective of the research was to catalog the species of Fabaceae occurring in the municipality of Coelho Neto/MA, and to elaborate a floristic list, for the subfamilies Caesalpinioideae, Cercidoideae, Detarioideae, Dialioideae, Duparquetioideae and Papilionoideae.

2. MATERIAL AND METHODS

2.1 Characterization of collection area

The state of Maranhão has a surface area of 331,983.29 km², being the eighth largest **Brasilian state** and the second in the Northeast in territorial extension. **It is** located between the parallels 01 ° 01 'and 10 ° 21' South and the meridians 41 ° 48 'and 48 ° 50' West. The state has five Geographical Mesoregions, subdivided into 21 Geographic Microregions, where its 217 municipalities are inserted [16].

In the Eastern Mesoregion of the state is the municipality of Coelho Neto-MA, with an area of 975,543 km² and 46,750 habitants according to the last census. Coelho Neto is located 361 km from the capital São Luís, Maranhão (Figure 1). The Municipality was created by Law 764, dated December 22, 1934 [17]. With Cerrado phytogeographic domain type, representing most of the vegetation cover, the municipality of Coelho Neto, together with other municipalities, have the Area of Environmental Protection of the Morros Garapenses, with 234,768 ha, created by Decree No. 25.087 of December 31 of 2008 [18].

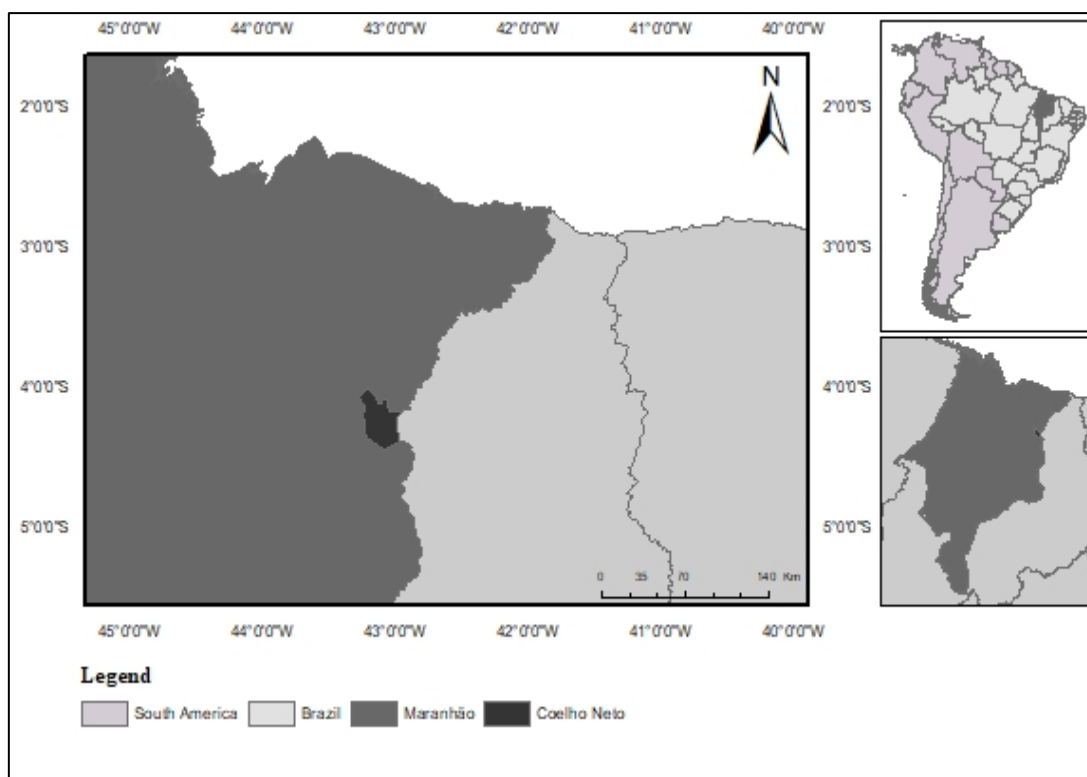


Fig. 1. Map of the Municipality of Coelho Neto, Maranhão/Brazil, collection area of the species of Fabaceae

2.2 Survey and treatment of botanical material

The floristic survey basically comprised three stages: fieldwork, analysis and identification and preparation of botanical material. Monthly expeditions, with duration of two to three days carried out in September 2016 to June 2017, to observe, collect and identify the botanical material in the municipality of Coelho Neto/MA. The botanical material was collected with pruning shears at reproductive stage and five samples of each specimen were bagged, following the standard methodology [19]. For each specimen collected, annotations were made, such as: date and place of collection (locality, municipality, state and geographic coordinates), name of collector, and physical characteristics of the environment (such as slope, soil type, watercourses, etc.).

The following traits were noted for each plant collection: plant habit of life, height, characteristic of the bark, color and texture of leaves, flowers and fruits and other striking features that will aid in species identification. In the botanical herborization process, the plant specimens were pressed between newspaper sheets, cardboard and dried at ambient environmental temperature. With the dehydrated material, they were fixed in paperboard, of appropriate size (28 x 42 cm), where they received labels with informative data, constituting the exsiccate.

The specimens collected were identified by comparison with the type material, specialized bibliographies [20,7,21,22,33], books, virtual herbarium and taxonomic keys following the recommended classification methodologies [24,2] and sending samples to specialists in the group for reconfirmation of identification. After the species identification and exsiccate assembly, they were allocated in Herbarium Prof. Aluizio Bittencourt (HABIT) together with other Fabaceae family exsiccates contained in the herbarium, where all identification and field

data were stored in exsiccate information sheets, organizing and updating the collection. Taxon nomenclature data, author, main work were obtained [25], geographic distribution and phytogeographic domains of the species according to the FLORA DO BRASIL digital platform under construction 2020. Richness, abundance, and sampling of the genus, species, habit of life and physiognomy in the survey were analyzed.

2.3 Rarefaction test

Was drawn up an interpolation and extrapolation rarefaction curve, stem from the datas of gathering analyzed. The rarefaction curve, as know as interpolation, has by pupose to estimate which could have being the strengths of species of a community, if the sample effort could have being narrow to an specific amount [26]. The analyses were held with the support from the software R 3.2.0 with the package iNEXT (R Development Core Team, 2015) and confidence interval of trust from 95%.

3. RESULTS AND DISCUSSION

The 41 specimens we sampled representing 14 genera and 22 species of Fabaceae found in the Municipality of Coelho Neto. Fabaceae is one of the families among the angiosperms that has the greatest species richness in the different phytogeographic domains of Brazil [28]. The representation of species and genera of the Fabaceae subfamilies sampled in this research indicate that of the 41 specimens studied, nine species belong to the subfamily Caesalpinioideae distributed in five genera, eight species and seven genera belong to Papilionoideae, one genus and four species of the subfamily Cercidoideae and one species of Detarioideae (Table 1). The highest species richness belongs to Caesalpinioideae, which has Pantropical distribution with wide morphological and reproductive variability [29].

As for the diversity of genera, Papilionoideae was the most represented subfamily with seven genera some of which showing a broad geographic distribution [2]. Regarding the genera under study, *Mimosa* was the most represented genus with five species, followed by *Bauhinia* with three species and *Aeschynomene* with two species respectively (Figure 2).

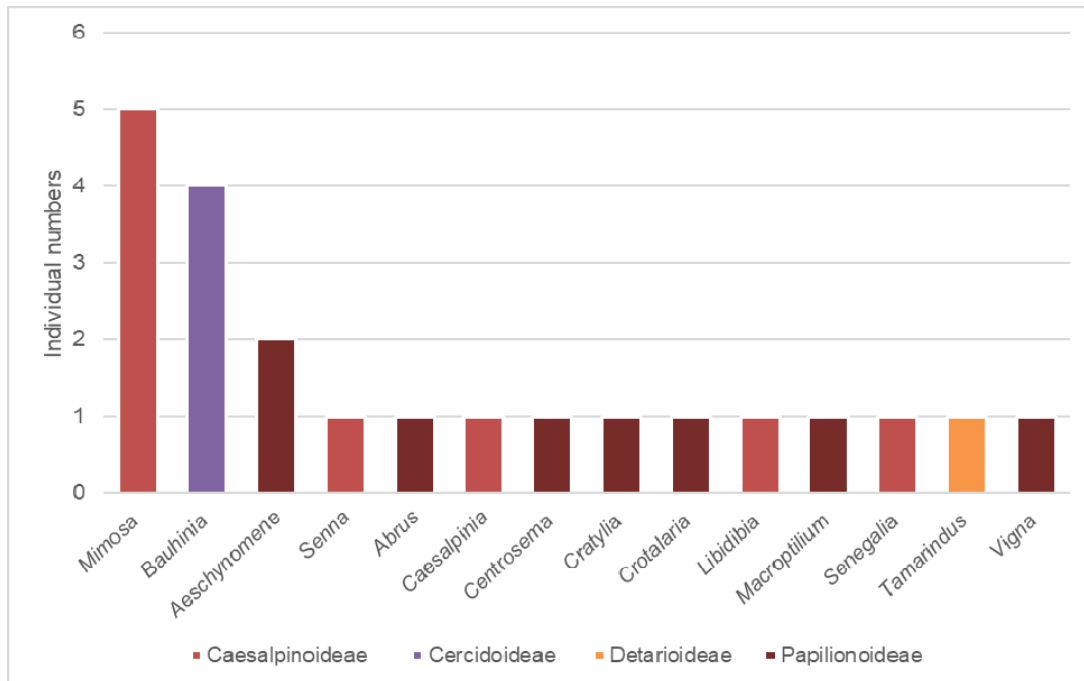


Fig. 2. Number of species sampled for each genus of Fabaceae

Mimosa L. comprises 540 species, being the second largest genus of the mimosoid clade [30,2], distributed mainly in the Neotropical region, with approximately 496 taxa of the Neotropics and 40 native species of the old world [29, 31]. The genus *Bauhinia* L. has Pantropical distribution, and approximately 160 species [32]. Among the 17 genera included in the *Dalbergieae* tribe, *Aeschynomene* stands out for its large morphological-vegetative variation and floral morphology, which makes it promising for phylogenetic and taxonomic studies. This genus has a pantropical distribution, comprising about 180 species [7], 84 of which occur in the Americas [33].

Regarding the habit of life of the studied species, it was observed that the habit of the herb type presented three individuals, subsequently the habit of the tree type with 6 and shrub with 13. It was observed that there was a greater representation with the type "**shrub**", as shown in (Figure 3). Species with shrub types predominated in the area, representing 12 species. However, other habits of life such as herbs and trees were observed, as found in Fabaceae works for Maranhão [34,35,36].

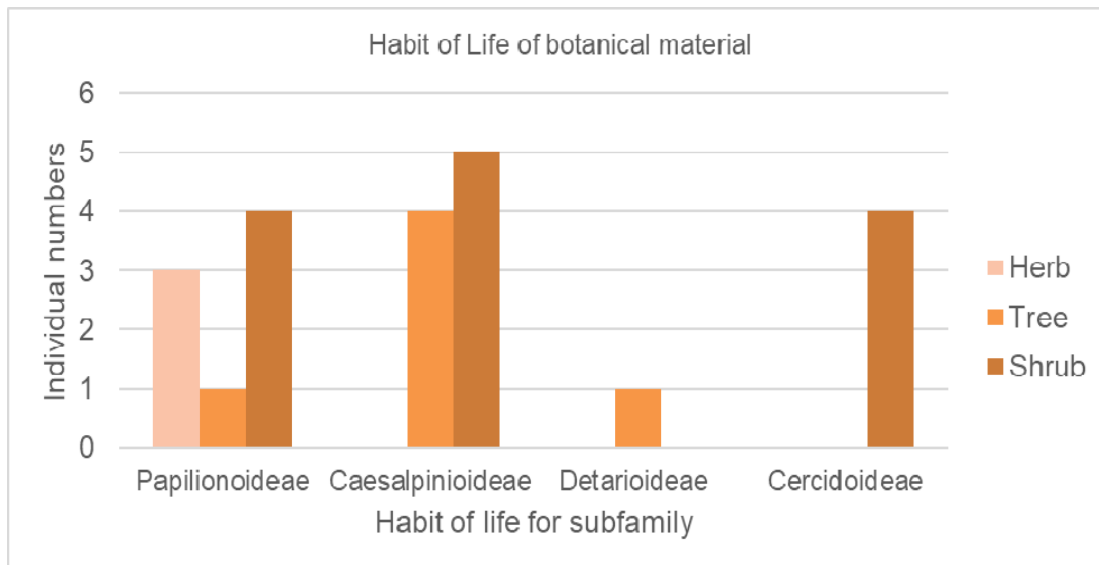


Fig. 3. Representation of habit of life of the species studied

The habit of **the** family is **variable**, from trees, shrubs, subshrubs to upright herbs, creeping or even climbing [28]. This habit of shrubs is characterized by woody structures of varying size, but not exceeding 6 m in height, and stem with branches very close to the ground [37]. The shrubs are comprised of woody plants, in which the support and stem tissues form layers that are added year after year [19].

As for the environment where the species were collected, all species were found in the gallery forest physiognomy. Among the vegetal formations of the Cerrado, the Mata de galeria, also known as Mata ripária or Mata ciliar by some researchers, is characterized by being associated to water courses, and this formation, although small, possesses richness, genetic diversity and acts in the protection of water resources [38].

Table 1. List of species of Fabaceae of the municipality of Coelho Neto/MA, distributed in their respective

Nº	SUBFAMILY	SPECIE	BRAZILIAN GEOGRAPHIC DISTRIBUTION	PHYTOGEOGRAPHIC DOMAIN
1.	CAESALPINIOIDEAE	<i>Caesalpinia pulcherrima</i> (L.) Sw.	AC, AM, AP, PA, RO, RR, TO, AL, BA, MA, PE, PI, RN, SE, DF, GO, MS, MT, ES, MG, RJ, SP, PR, RS, SC.	Amazon forest, Cerrado e Atlantic forest.
2.		<i>Libidibia ferrea</i> (Mart. Ex Tul.) L.P Queiroz	AL, BA, CE, MA, PB, PE, PI, RN, SE, ES, MG, RJ.	Caatinga, Cerrado e Atlantic forest.
3.		<i>Mimosa candollei</i> R. Grether	AC, AM, AP, PA, RO, RR, TO, AL, BA, CE, MA, PB, PE, PI, RN, SE, DF, GO, MS, MT, ES, MG, RJ, SP, PR, SC.	Amazon forest, Caatinga, Cerrado e Atlantic forest.
4.		<i>Mimosa pigra</i> L.	AC, AM, AP, PA, RO, RR, TO, AL, BA, CE, MA, PB, PE, PI, RN, SE, DF, GO, MS, MT, ES, MG, RJ, SP, PR, SC.	Amazon forest, Caatinga, Cerrado, Atlantic forest e Pantanal.
5.		<i>Mimosa sensitiva</i> L.	AM, PA, RO, TO, AL, BA, CE, MA, PE, PI, RN, SE, DF, MS, MT, ES, MG, RJ, SP.	Amazon forest, Caatinga, Cerrado e Atlantic forest.
6.		<i>Mimosa acutistipula</i> (Mart.) Benth.	PA, BA, CE, MA, PE, PI, DF, GO, MS, MT, RJ.	Amazon forest, Caatinga, Cerrado e Atlantic forest.
7.		<i>Mimosa xanthocentra</i> Mart.	PA, RO, TO, BA, CE, MA, PI, DF, GO, MS, MT, MG, RJ, SP, PR, SC.	Amazon forest, Cerrado e Atlantic forest.
8.		<i>Senegalia polyphylla</i> (DC.) Britton	AM, PA, AL, BA, CE, MA, PB, PI, SE, DF, GO, MS, MT, ES, MG, RJ, SP, PR.	Amazon forest, Caatinga, Cerrado, Atlantic forest e Pantanal.
9.		<i>Senna velutina</i> (Vogel) H.S. Irwin & Barneby	TO, BA, CE, MA, PI, DF, GO, MS, MT, MG, SP.	Amazon forest, Caatinga e Cerrado.
10.		<i>Bauhinia forficata</i> Link	AL, BA, MA, PE, ES, MG, RJ, SP, PR, RS, SC.	Atlantic forest e Cerrado
11.	CERCIDOIDEAE	<i>Bauhinia cupulata</i> Benth.	PA, TO, BA, MA, PI, GO, MT.	Amazon forest, Caatinga e Cerrado.

12.	<i>Bauhinia dubia</i> G. Don.	AM, PA, TO, CE, MA, PI.	Amazon forest e Cerrado.
13.	<i>Bauhinia unguolata</i> L.	AC, AM, AP, PA, RO, RR, TO, BA, CE, MA, PI, DF, GO, MS, MT, MG, RJ, SP.	Amazon forest, Cerrado e Atlantic forest.
14.	<i>Tamarindus indica</i> L.	AC, AM, AP, PA, RO, RR, TO, AL, BA, CE, MA, PB, PE, PI, RN, SE, DF, GO, MS, MT, ES, MG, RJ, SP, PR, RS, SC.	Amazon forest, Caatinga, Cerrado e Atlantic forest.
DETARIOIDEAE			
15.	<i>Abrus fruticulosus</i> Wight & Arn.	AM, AP, PR, RR, AL, BA, CE, MA, PB, PE, PI, RN, SE, DF, GO, MS, MT, ES, MG, RJ, SP, PR, SC.	Amazon forest e Cerrado.
16.	<i>Aeschynomene brasiliana</i> (Poir.) DC.	AM, AP, PA, RO, RR, TO, AL, BA, CE, MA, PB, PE, PI, DF, GO, MS, MT, ES, MG, RJ, SP, PR.	Amazon forest, Caatinga, Cerrado, Atlantic forest e Pantanal.
17.	<i>Aeschynomene Rudis</i> Benth.	AM, AP, PA, AL, BA, CE, MA, PB, PE, PI, RN, MS, ES, MG, SP, PR, RS, SC.	Amazon forest, Caatinga, Cerrado, Atlantic forest, Pampa e Pantanal.
18.	<i>Centrosema brasiliana</i> (L.) Benth.	AM, AP, PA, RR, AL, BA, CE, MA, PB, PE, PI, RN, SE.	Amazon forest, Caatinga, Cerrado, Atlantic forest e Pantanal.
19.	<i>Cratylia argentea</i> (Desv.) Kuntze	AC, PA, RO, TO CE, MA, PI, DF, GO, MT, MG.	Amazon forest, Caatinga e Cerrado
PAPILIONOIDEAE			
20.	<i>Crotalaria retusa</i> L.	PA, BA, MA, PI, MG, RJ, SP, PR, RS, SC.	Amazon forest, Caatinga, Cerrado, Atlantic forest e Pampa.
21.	<i>Macroptilium lathyroides</i> (L.) Urb.	AM, PA, RR, AL, BA, CE, MA, PB, PE, PI, DF, GO, MS, MT, ES, MG, RJ, SP, PR.	Amazon forest, Cerrado, Atlantic forest e Pantanal.
22.	<i>Vigna unguiculata</i> (L.) Walp.	RN, MS, MT, MA, MG, RJ, SP, PR,	Amazon forest, Cerrado e Atlantic forest.

Meanings of the acronyms of brazilian geographical distribution: ACRE-AC; ALAGOAS-AL; AMAPÁ-AP; AMAZONAS-AM; BAHIA-BA; CEARÁ-CE; DISTRITO FEDERAL-DF; ESPÍRITO SANTO-ES; GOIÁS-GO; MARANHÃO-MA; MATO GROSSO-MT; MATO GROSSO DO SUL-MS; MINAS GERAIS-MG; PARÁ-PA; PARAÍBA-PB; PARANÁ-PR; PERNAMBUCO-PE; PIAUÍ-PI; RIO DE JANEIRO-RJ; RIO

GRANDE DO NORTE-RN; RIO GRANDE DO SUL-RS; RONDÔNIA-RO; RORAIMA-RR; SANTA CATARINA-SC; SÃO PAULO-SP;
SERGIPE-SE;TOCANTINS-TO

As shown in the interpolation and extrapolation rarefaction curve (Figure 4), the amount of species to the study area is much higher, when compared to with the shown number. Was documented 22 species, spread between 41 individuals in four subfamilies (Table 2), with the rarefaction curve estimate to the area 31 species and 80 individuals.

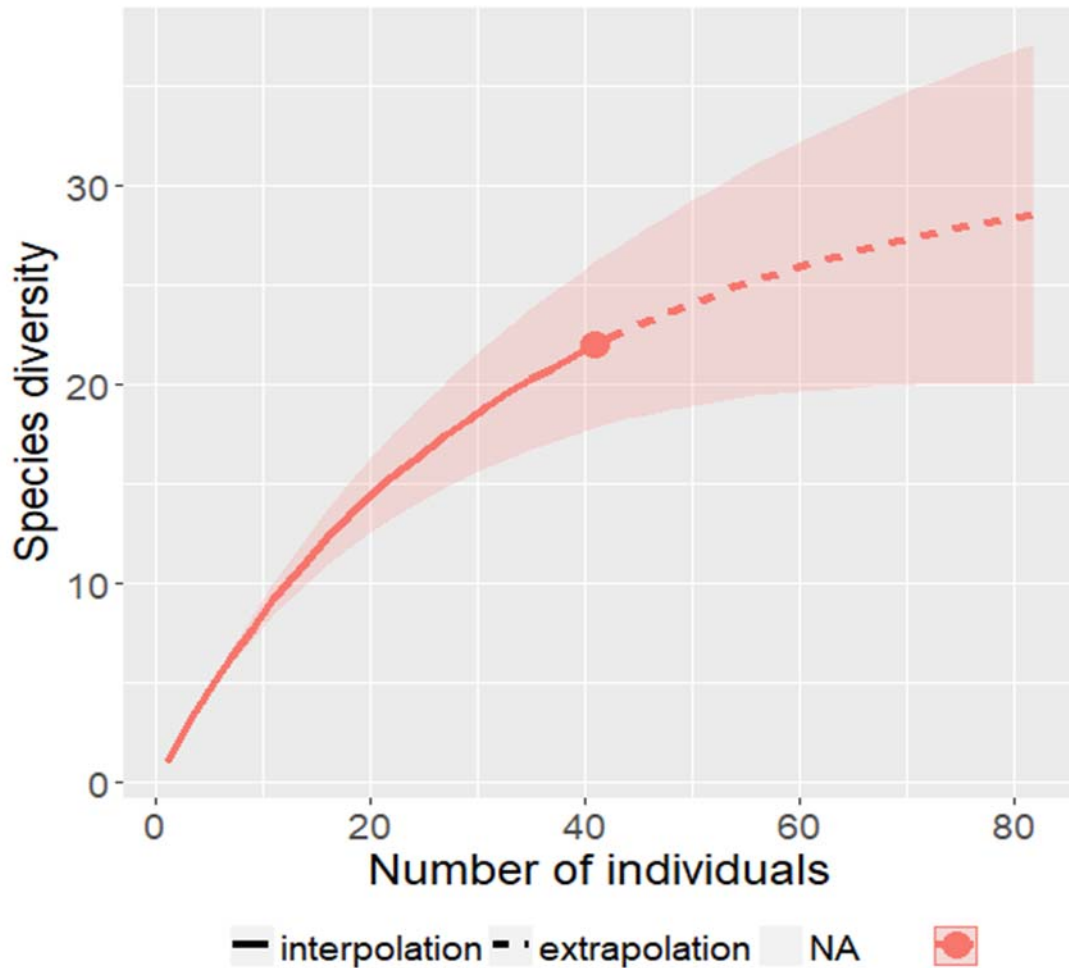


Fig. 4. Interpolation and extrapolation rarefaction curve from the data collection data, with confidence interval (95%)

The floristic studies, look up to know many species as possible, albeit the bind in the sampling [39]. The specimen research was meaningful to put forward thereabouts 71% of the species and 51,2% of the individuals of the extrapolated sample. The rarefaction curve shows the advantage to lay down a confidence interval with differences statistically significant between the curve and their [40]

Table 2. Distribution of species number (S / N), number of individuals (N / I) and number of genera (N / G) in relation to Fabaceae subfamilies found in the study area, Maranhão / Brazil

Subfamily	S/N	N/I	N/G
Caesalpinioideae	9 (40,9%)	17(41,5%)	5 (35,8%)
Cercidoideae	4 (18,2%)	9 (22%)	1 (7,1%)
Detarioideae	1 (4,5%)	1 (2,4%)	1(7,1%)
Papilionoideae	8 (36,4%)	14 (34,1%)	7 (50%)
Total	22	41	14

Despite the high estimation of species of Fabaceae in the Brazilian Northeast, the family is still sub-sampled, considering areas not yet collected, including Maranhão, which requires specific floristic surveys of diversity to fill gaps and uncertainties of plant occurrence information a central problem in ecology and conservation has been demonstrated [41].

4. CONCLUSION

The study area presented 14 genera, distributed in 22 species of the family Fabaceae, sampled in four subfamilies, with Papilionoideae with higher taxon richness, predominating shrub species, which are characteristic of the Cerrado ecosystem.

The species composition of the area for the Cerrado helps to understand the floristic formation of these ecosystems, helping to fill gaps in the biodiversity of Brazil and the world, despite the various anthropic evidences for the study area that put the vegetal species of the Cerrado in threat of extinction. The results will serve as basis for the elaboration of plans for the management and conservation of species, helping to computerize the conservation status of each group, directed to the preservation of environments and species of Fabaceae.

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