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Characterization of melliferous species in the tropical dry forest oriented to their conservation

Caracterización de las especies melíferas en el bosque seco tropical orientada a su conservación

Caracterização de espécies de mel da floresta tropical seca visando sua conservação

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ABSTRACT

In the Quimis area of the Jipijapa Canton, an investigation was carried out related to the characterization of plant species that provide sustenance to bees in the production of honey that is used by local residents involved in the Aroma y Miel Association, among other uses, to market it. The objective of this study was based on characterizing the melliferous species of the tropical dry forest oriented to its conservation. Seven active apiaries distributed within the enclosure were selected, where four weekly samplings were made, with a total of 28 transects of 20 m x 50 m, taking as a starting point the



apiaries to identify and count the number of species of apicultural use. A total of 31 species, 1,527 individuals, belonging to 16 families were determined. The botanical family with the highest abundance was Fabaceae with 290 individuals, and the most abundant species were *Ceiba trichistandra* (A. Gray) Bakh and *Prosopis pallida* (Willd.) Kunth, due to the greater beekeeping use and commercialization. The most frequent biological types were trees, followed by shrubs, herbaceous and lianas, respectively. The months of greatest flowering are from March to the beginning of October.

Palabras clave: Trees; Dry forest; Bee flora; Flowers.

RESUMEN

En el recinto Quimis del Cantón Jipijapa, se realizó una investigación relacionada con la caracterización de las especies vegetales que proveen de sustento a las abejas en la producción de miel que es aprovechada por los residentes locales involucrados en la Asociación Aroma y Miel, para entre otros usos, comercializarla. El objetivo de este estudio se basó en caracterizar las especies melíferas del bosque seco tropical orientada a su conservación. Se seleccionaron siete apiarios activos distribuidos dentro del recinto, donde se realizaron cuatro muestreos semanales, con un total de 28 transectos de 20 m x 50 m, tomando como punto de partida los apiarios para identificar y contar el número de especies de aprovechamiento apícola. En total se determinaron 31 especies, 1 527 individuos, pertenecientes a 16 familias. La familia botánica con mayor abundancia fue Fabaceae con 290 individuos, y las especies más abundantes fueron *Ceiba trichistandra* (A. Gray) Bakh y *Prosopis pallida* (Willd.) Kunth, debido al mayor uso apícola y comercialización. Los tipos biológicos más frecuentes resultaron ser los árboles, seguidos de los arbustos, las herbáceas y las lianas, respectivamente. Los meses de mayor floración se enmarcan entre marzo hasta inicios de octubre.

Palabras clave: Árboles; Bosque seco; Flora apícola; Flores.

RESUMO

No recinto Quimis do Cantão de Jipijapa, foi realizada uma investigação relacionada à caracterização das espécies vegetais que fornecem sustento às abelhas na produção do mel que é utilizado pelos moradores locais envolvidos na Associação Aroma y Miel, entre outras. utiliza, comercializa. O objetivo deste estudo baseou-se na caracterização das espécies de mel da floresta tropical seca visando a sua conservação. Foram selecionados sete apiários ativos distribuídos dentro do recinto, onde foram realizadas quatro coletas semanais, totalizando 28 transectos de 20 m x 50 m, tendo os apiários como ponto de partida para identificação e contagem do número de espécies utilizadas na apicultura. No total, foram determinadas 31 espécies, 1 527 indivíduos, pertencentes a 16 famílias. A família botânica com maior abundância foi Fabaceae com 290 indivíduos, e as espécies mais abundantes foram *Ceiba trichistandra* (A. Gray) Bakh e *Prosopis pallida* (Willd.) Kunth, devido ao maior uso apícola e comercialização. Os tipos biológicos mais frequentes foram árvores, seguidas de arbustos, herbáceas e lianas, respectivamente. Os meses de maior floração vão de março até o início de outubro.

Palavras-chave: Árvores; Floresta seca; Flora apícola; Flores.



INTRODUCTION

According to the Food and Agriculture Organization of the United Nations (FAO, 2018), forests are home to more than three quarters of the world's terrestrial biodiversity and constitute an invaluable resource for the socio-economic development of hundreds of millions of people, mainly in rural areas. Among the main causes of forest loss are conversion to other land uses, mostly agriculture, deforestation, degradation and illegal logging practices.

Additionally, the recovery of forested areas, the reduction of logging and proper forest management have become priority activities to restore forests, the biodiversity they harbor and the environmental services they provide, as a strategy to cope with the effects of climate change (Miranda 2019).

Ecuador is a country rich in natural resources, with a climatic and biological diversity such as tropical and Andean forests (Vivanco, Rosillo and Macias, 2020). Beekeeping enterprises at the level of the country and the province of Manabí, are generally at a medium level with techniques oriented for sustainable management in order to obtain a good production (Guallpa, Guilcapi and Espinoza, 2019).

Bee flora or melliferous flora is known as the set of plant species in a region that produce substances or elements that bees collect for their benefit, generally nectar and pollen (Tejeda *et al.*, 2019).

Other authors such as May and Rodríguez (2012), state that, in order to know possible conservation and restoration needs of ecosystems and to be able to adapt apiary management to changes in natural potential, it is important to have a good knowledge of the plants whose flowers the bees use to obtain honey and pollen, in their flowering seasons, and of the landscape components in which they are present. Such knowledge can also be used to assess the potential for producing honeys of a particular floral origin, which is important for marketing in international markets.

According to the Agencia Ecuatoriana Aseguramiento de la Calidad del Agro [AGROCALIDAD] (2017), Ecuadorian beekeeping is distributed in 902 beekeeping farms, of which 63 % are located in the highlands, 27 % in the coast, and 4 % in the Amazon. The land registry operation registered 12,188 hives, distributed with 46% in two-story hives, 27 % in one-story hives, and 14 % in three-story hives.

The present investigation has been elaborated in the framework of the projects, "Components of the biological diversity used by the families of Manabí in the natural and traditional medicine", by the majoring on forest engineering, and "Biodiversity and Tourism in the coastal region of Ecuador", of the majoring on tourism, financed by the State University of the South of Manabí and has as objective to characterize the melliferous species that are in the Quimis enclosure, canton Jipijapa, oriented to its conservation.



MATERIALS AND METHODS

Location of the area

The Quimis area belongs to the Jipijapa canton, it is located to the south of the Province of Manabí, it limits to the North with the parroquia La Pila; to the South with the Sancán community; to the East with the Cerrito la Asunción area and to the West, with the Membrillal parroquia.

Methodology

To characterize the melliferous species found in the Quimis enclosure, seven apiaries located in areas of the tropical dry forest described by the Ministry of Environment (MAE 2013) were investigated (Figure 1).

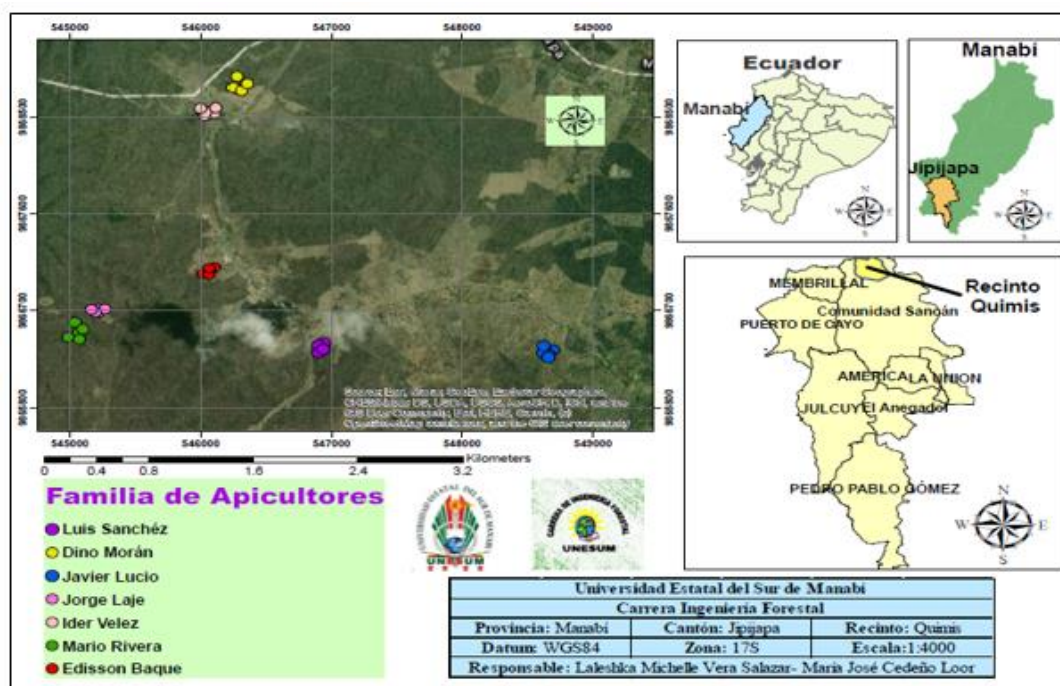


Figure 1. - Location of the transects carried out in the area of influence of the seven selected active apiaries in the tropical dry forest of the Quimis area

The collected species were grouped by families, analyzing aspects of each taxa such as biological type, texture, and leaf size; then the chorological types were classified according to Borhidi (1996); the biological types of Raunkiaer (1905) determined according to the key of Ellenberg and Mueller-Dombois (1966, 1967); as well as the morphological characteristics and texture of the leaves (Valdés and Paneque 2008; Aguirre 2012).

As a reference to the classification of pollen and nectar obtained from the species found in the study, the criteria of Insuasty, Martinez and Jurado (2016) were taken into account.



In order to know the threat status of the melliferous species found in the Quimis area the Red List of the flora of Ecuador (International Union for Conservation of Nature) was reviewed (IUCN 2020). In the identification and taxonomic classification of the bee flora, the criteria of Insuasty, Martínez, and Jurado (2016) were taken into account.

The nomenclature of the melliferous species cited in the Quimis area was determined by reviewing the Tropics database of the Botanical Information System at the Missouri Botanical Garden, and the Catalogue of Life (Roskov *et al.*, 2019), as for the Quimis area (Tropics 2020) and the Catalogue of Life (Roskov *et al.*, 2019), while common names were provided by local guides (Jiménez 2012); (Jiménez *et al.*, 2016). On the other hand, the categories of cultivated, wild, endemic or introduced flora species were determined by reviewing the Red Book of the Flora of Ecuador (León *et al.*, 2011) and the Encyclopedia of Useful Plants of Ecuador (De la Torre *et al.*, 2008).

To carry out the transects, the methodology described by Aguilar *et al.*, (2019) was used, in which, after selecting the active apiaries, four weekly samples were taken per apiary using transects of 20 x 50 m, thus the apiaries were taken as a starting point to identify and count the number of beekeeping species. During the tours and visits to the site, an invitation was received to attend a honey harvest in the apiary of Mr. Mario Rivera.

Data analysis

Shannon's index and the reciprocal of Simpson's index were calculated, with the objective of determining the species with the highest diversity in the forest that supports the life of the studied apiaries; according to what was reported by Jiménez *et al.* (2021), beekeepers have knowledge about the existing vegetation in the Quimis area, however, they do not know the totality of the melliferous species that exist around their apiaries and at the same time it was confirmed that *Apis mellifera* bees obtain food from several species which were not mentioned by the interviewees in that study.



RESULTS

Characterization of melliferous species found in the Quimis area, Jipijapa canton

A total of 31 species were inventoried distributed in the seven apiaries established in Quimis (Table 1) with a total of 1527 individuals.

Table 1. - Species identified in the Tropical Dry Forest of the Quimis site

Scientific name	Families
<i>Prosopis pallida</i> (Willd.) Kunth	Fabaceae
<i>Bonellia sprucei</i> (Mez) B. Ståhl & Källersjö	Primulaceae
<i>Caesalpinia paipai</i> Ruiz & Pav.	Fabaceae
<i>Ceiba trischistandra</i> (A. Gray) Bakh.	Malvaceae
<i>Trema micrantha</i> (L.) Bl.	Cannabaceae
<i>Croton rivinifolius</i> Kunth	Euphorbiaceae
<i>Acnitus arborencens</i> (L.) Schltld.	Solanaceae
<i>Pithecellobium arboreum</i> (L.) Urb.	Fabaceae
<i>Sarcomphalus thyrsoiflorus</i> (Benth.) Hauenschild.	Rhamnaceae
<i>Convolvulus arvensis</i> L.	Convolvulaceae
<i>Ipomoea purpurea</i> (L.) Roth	Convolvulaceae
<i>Xenostegia medium</i> (L.) D. F. Austin & G. W. Staples	Convolvulaceae
<i>Vachellia macracantha</i> (Humb. & Bonpl. ex Willd.) Seigler & Ebinger	Fabaceae
<i>Guazuma ulmifolia</i> Lam.	Malvaceae
<i>Eriotheca ruizii</i> (K. Schum.) A. Robyns	Malvaceae
<i>Leucaena trichodes</i> (Jacq.) Benth.	Fabaceae
<i>Coccoloba ruiziana</i> Lindau	Polygonaceae
<i>Mimosa acantholoba</i> (Willd.) Poir.	Fabaceae
<i>Cordia lutea</i> Lam.	Ehretiaceae
<i>Muntingia calabura</i> L.	Muntingiaceae
<i>Bursera graveolens</i> (Kunth) Triana & Planch.	Burseraceae
<i>Guapira floribunda</i> (Hook. fil.) Lundell.	Nyctaginaceae
<i>Erythrina velutina</i> Willd.	Fabaceae
<i>Vallesia glabra</i> (Cav.) Link	Apocynaceae
<i>Jatropha curcas</i> L.	Euphorbiaceae
<i>Pithecellobium excelsum</i> (Kunth) Mart.	Fabaceae
<i>Cynophalla flexuosa</i> (L.) J. Presl	Capparaceae
<i>Capparicordis crotonoides</i> (Kunth) Iltis & Cornejo	Capparaceae
<i>Geoffroea spinosa</i> Jacq.	Fabaceae
<i>Pisonia aculeata</i> L.	Nyctaginaceae
<i>Colicodendron scabridum</i> (Kunth) Hutchinson	Capparaceae



Among the most represented are the Fabaceae family with nine species, followed by the families Malvaceae, Capparaceae, Convolvulaceae with three species each one.

In Figure 2, the results of the abundance by families are presented, reaching the highest value Fabaceae, with 290 individuals, while the family Apocynaceae has only one individual (Figure 2).

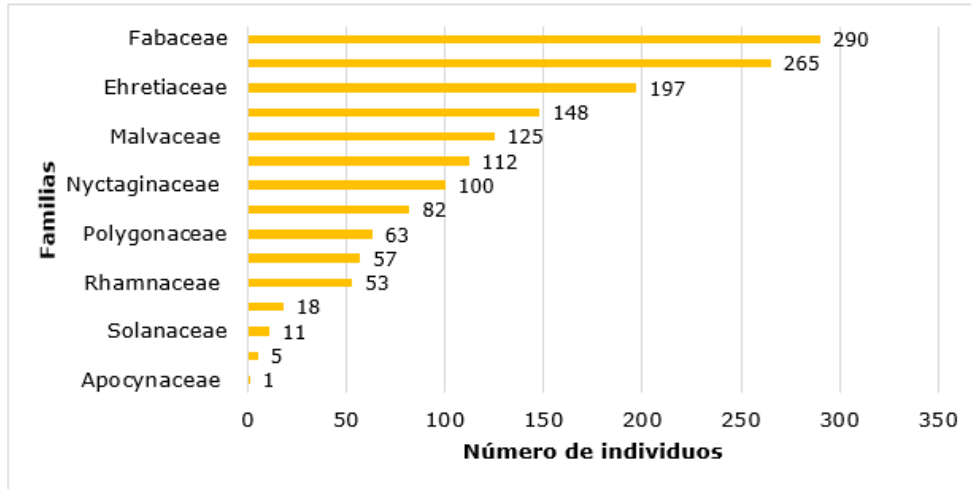


Figure 2. - Most represented families according to the number of individuals in the Tropical Dry Forest of the Quimis site

Conservation status according to IUCN

As mentioned in Table 2, the Red List Category, for the most part, the species found in the Tropical Dry Forest of the Quimis area are in a conservation status of least concern (LC) or species with insufficient data (DD). On the other hand, the species *Pithecellobium arboreum* is the only species in the fourth category called "Vulnerable (VU), likewise *Croton rivinifolius* is the only species that is "Endangered (EN)" (Table 2).



Table 2. - Conservation status of melliferous species of the tropical dry forest in the Quimis area

Scientific name	IUCN Category							
	DD	LC	NT	VU	EN	CR	EW	EX
<i>Mimosa acantholoba</i>		X						
<i>Pythecellobium arboreum</i>				X				
<i>Caesalpinia paipai</i>		X						
<i>Pithecellobium excelsum</i>		X						
<i>Geoffroea spinosa</i>		X						
<i>Erythrina velutina</i>								
<i>Prosopis pallida</i>								
<i>Vachellia macracantha</i>								
<i>Leucaena trichodes</i>								
<i>Jatropha curcas</i>		X						
<i>Croton rivinifolius</i>					X			
<i>Pisonia aculeata</i>		X						
<i>Guapira floribunda</i>		X						
<i>Bursera graveolens</i>		X						
<i>Muntingia calabura</i>								
<i>Trema micrantha</i>								
<i>Ceiba trichistandra</i>		X						
<i>Eriotheca ruizii</i>								
<i>Guazuma ulmifolia</i>		X						
<i>Cordia lutea</i>		X						
<i>Xenostegia médium</i>								
<i>Convolvulus arvensis</i>								
<i>Ipomoea purpurea</i>								
<i>Acnitus arborencens</i>								
<i>Sarcomphalus thyrsoiflorus</i>								
<i>Coccoloba ruiziana</i>								
<i>Vallesia glabra</i>		X						
<i>Cynophalla flexuosa</i>		X						
<i>Colicodendron scabridum</i>		X						
<i>Capparicordis crotonoides</i>								
<i>Bonellia sprucei</i>								

Note: DD= data deficient; LC= Least Concern; NT= Near Threatened; VU= Vulnerable; EN= Endangered; CR= Critically Endangered; EW=Extinct in the Wild; EX=Extinct from the Wild.

Chorological classification

The results of the chorology are presented in (Table 3, Table 4 and Table 5).



Table 3. - Biological types and forest types of the melliferous species inventoried in the Quimis area

Scientific name	Biological type	Forest type
<i>Mimosa acantholoba</i>	Mcp	Bsp
<i>Pithecellobium arboreum</i>	Msp	Bsp
<i>Caesalpinia paipai</i>	McMsp	Bsp
<i>Pithecellobium excelsum</i>	M-Mcp	Bsp
<i>Geoffroea spinosa</i>	Msp	Bsp/Bsa
<i>Erythrina velutina</i>	Msp	Bsp
<i>Prosopis pallida</i>	McMsp	Bsp/Bsa
<i>Vachellia macracantha</i>	McMsp	Bsp/Bsa
<i>Leucaena trichodes</i>	M-Mcp	Bsp
<i>Jatropha curcas</i>	M-Mcp	Bsp/Bsa
<i>Croton rivinifolius</i>	Mcp	Bsp/Bsa
<i>Pisonia aculeata</i>	Mcp	Bsp/Bsa
<i>Guapira floribunda</i>	Msp	Bsp
<i>Bursera graveolens</i>	Msp	Bsp/Bsa
<i>Eriotheca ruizii</i>	Msp	Bsp
<i>Muntingia calabura</i>	Msp	Bsp/Bsa/Bsap
<i>Trema micrantha</i>	Mcp	Bsp/Bsa/BsvtbC
<i>Ceiba trichistandra</i>	Mgp	Bsp/Bsa
<i>Guazuma ulmifolia</i>	McMsp	Bsp/Bsa
<i>Cordia lutea</i>	Mcp	Bsp/Bsa
<i>Xenostegia médium</i>	P	Bsp/Bsa
<i>Convolvulus arvensis</i>	H	Bsp/Bsa
<i>Ipomoea purpurea</i>	H	Bsp/Bsa
<i>Acnitus arborencens</i>	Mcp	Bsp/Bsa
<i>Sarcomphalus thyrsoiflorus</i>	Msp	Bsp
<i>Coccoloba ruiziana</i>	Mcp	Bsp
<i>Vallesia glabra</i>	M-Mcp	Bsp/Bsa
<i>Cynophalla flexuosa</i>	McMsp	Bsp/Bsa
<i>Colicodendron scabridum</i>	Msp	Bsp/Bsa
<i>Capparicordis crotonoides</i>	M-Mcp	Bsp
<i>Bonellia sprucei</i>	McMsp	Bsp

Legend: biological types: microphanerophytes (Mcp)= small between 5- 10 m; mesophanerophytes (Msp)= trees 15- 30 m; micromesophanerophytes (McMsp)= small to medium-sized trees 8- 15 m; micronano-panerophytes (M-Mcp)= woody plants between 2- 5 m; hemicryptophytes (H)= perennial herbs with buds on the soil surface; phanerophytes (P)= plants with woody stems, shrubs or herbs with stems over 50 cmtall; mega-phyanerophytes (Mgp)= large trees, over 30 m; dry forest type: Bsp= pluvio-seasonal dry forest; Bsa= Andean dry forest; Bsap= piedmont Andean evergreen forest; BsvtbC= lowland evergreen forest Chocó.



Table 4. - Characteristics of the leaves of the species of the Tropical Dry Forest of the Quimis site

Scientific name	Blade type	Composite sheet type	Sheet size	Leaf edge	Leaf shape	Leaf texture
<i>Mimosa acantholoba</i>	Hc	Cbi	Nan	Be	Fli	Car
<i>Pithecellobium arboreum</i>	Hc	Cbi	Lep	Be	Fli	Car
<i>Caesalpinia paipai</i>	Hc	Cbi	Nan	Be	Fova	Mem
<i>Pithecellobium excelsum</i>	Hc	Cbi	Mic	Be	Fova	Car
<i>Geoffroea spinosa</i>	Hc	Cbi	Lep	Be	Fli	Car
<i>Erythrina velutina</i>	Hc	Ctri	Not	Bl	Fe	Mem
<i>Prosopis pallida</i>	Hc	Cbi	Nan	Be	Fli	Mem
<i>Vachellia macracantha</i>	Hc	Cbi	Nan	Be	Fob	Mem
<i>Leucaena trichodes</i>	Hc	Cimp	Mic	Be	Fl	Car
<i>Jatropha curcas</i>	Hs		Not	Bl	Ft	Mem
<i>Croton rivinifolius</i>	Hs	Ctri	Not	Be	Fl	Car
<i>Pisonia aculeata</i>	Hs		Mic	Be	Fl	Mem
<i>Guapira floribunda</i>	Hs		Not	Be	Fe	Mem
<i>Bursera graveolens</i>	Hc	Cimp	Not	Bd	Fc	Mem
<i>Eriotheca ruizii</i>	Hs		Not	Bl	Fe	Mem
<i>Muntingia calabura</i>	Hs		Not	Bd	Fl	Suc
<i>Trema micrantha</i>	Hs		Not	Be	Fe	Mem
<i>Ceiba trichistandra</i>	Hc	Cpa	Mes	Be	Fe	Car
<i>Guazuma ulmifolia</i>	Hs		Not	Bd	Fl	Mem
<i>Cordia lutea</i>	Hs		Not	Bd	Fe	Cor
<i>Xenostegia médium</i>	Hs		Not	Bl	Fc	Mem
<i>Convolvulus arvensis</i>	Hs		Not	Bl	Ft	Suc
<i>Ipomoea purpurea</i>	Hs		Not	Bl	Ft	Mem
<i>Acnitus arborencens</i>	Hs		Not	Be	Fe	Suc
<i>Sarcomphalus thyrsoiflorus</i>	Hs		Not	Bd	Fob	Car
<i>Coccoloba ruiziana</i>	Hs		Not	Be	Fov	Car
<i>Vallesia glabra</i>	Hs		Mic	Be	Fl	Suc
<i>Cynophalla flexuosa</i>	Hc	Cimp	Mic	Be	Fa	Cor
<i>Capparicordis crotonoides</i>	Hs		Not	Be	Fl	Cor
<i>Colicodendron scabridum</i>	Hs		Not	Be	Fz	Cor
<i>Bonellia sprucei</i>	Hc	Cimp	Mes	Be	Fo	Cor

Legend: leaf type: Hs= simple leaf; Hc= compound leaf; compound leaf type: Cbi= compound bifoliate leaves; Cimp= compound imparipinnate leaves; Ctri= compound trifoliate leaves; Cpa= compound palmate leaves; leaf size: nanophyllous (Nan)= area up to 0.25 cm² and length 0.5 - 1cm; notophyllous (Not)= area up to 12.5 cm² and length 6-23cm; microphyllous (Mic)= area 1.75 cm² and length 1- 6 cm; leptophyllous. (Lep)= small leaves with an area of less than 0.25 cm² and length of 1-5 mm; mesophilic (Mes)= area up to 2.5 cm² and length of 13- 20 cm; mapophyllous. (Af)= leafless; leaf margin: Be= entire margin; Bl= lobed margin; Bd= serrated margin; leaf shape: Fli= linear shape; Fe= elliptic shape; Fl= lanceolate shape; Fova= ovate shape; Fob= oblong shape; Ft= triangular shape; Fc= cordate shape; Fo= oblanceolate shape; Fz= tendril shape; Fov= ovate shape; Fa= acicular shape; leaf texture: cartaceous (Car)= like cardboard or paper; membranous (Mem)= extremely soft in texture; coriaceous (Cor)= leather-like hard; succulent (Suc)= fleshy.



Table 5. - Characteristics of the trunks of the species of the Tropical Dry Forest of the Quimis site

Scientific name	Stem type	Texture of the crust
<i>Mimosa acantholoba</i>	Tl	Tr
<i>Pithecellobium arboretum</i>	Tl	Tr
<i>Caesalpinia paipai</i>	Tl	Tli
<i>Pithecellobium excelsum</i>	Tl	Tr
<i>Geoffroea spinosa</i>	Tl	Tr
<i>Erythrina velutina</i>	Tl	Tli
<i>Prosopis pallida</i>	Tl	Tr
<i>Vachellia macracantha</i>	Tl	Tr
<i>Leucaena trichodes</i>	Tl	Tli
<i>Jatropha curcas</i>	Tl	Tli
<i>Croton rivinifolius</i>	Tl	Tli
<i>Pisonia aculeata</i>	Tl	Tli
<i>Guapira floribunda</i>	Tl	Tli
<i>Bursera graveolens</i>	Tl	Tli
<i>Eriotheca ruizii</i>	Tl	Tli
<i>Muntingia calabura</i>	Tl	Tli
<i>Trema micrantha</i>	Tl	Tr
<i>Ceiba trichistandra</i>	Tl	Tli
<i>Guazuma ulmifolia</i>	Tl	Tr
<i>Cordia lutea</i>	Tl	Tr
<i>Xenostegia medium</i>	Th	Tli
<i>Convolvulus arvensis</i>	Th	Tli
<i>Ipomoea purpurea</i>	Lia	Tli
<i>Acnitus arborencens</i>	Tl	Tli
<i>Sarcomphalus thyrsoiflorus</i>	Tl	Tli
<i>Coccoloba ruiziana</i>	Tl	Tli
<i>Vallesia glabra</i>	Tl	Tr
<i>Cynophalla flexuosa</i>	Tl	Tr
<i>Capparicordis crotonoides</i>	Tl	Tr
<i>Colicodendron scabridum</i>	Tl	Tr
<i>Bonellia sprucei</i>	Tl	Tr

Legend: stem type: Tl=woody stem; Th=herbaceous stem; Lia= liana; stem texture: Tli=smooth stem; Tr= rough stem.



The results of melliferous species according to pollen supply, nectar supply or both (Table 6).

Table 6. - Distribution of melliferous species according to their contribution of pollen and nectar to bees in honey production

Melliferous species	Pollen	Nectar	Pollen/Nectar
<i>Acnitus arborencens</i>		X	
<i>Vachellia macracantha</i>			X
<i>Pithecellobium excelsum</i>			X
<i>Ceiba trichistandra</i>			X
<i>Guazuma ulmifolia</i>			X
<i>Capparicordis crotonoides</i>			X
<i>Colicodendron scabridum</i>			X
<i>Prosopis pallida</i>			X
<i>Eriotheca ruizii</i>			X
<i>Convolvulus arvensis</i>		X	
<i>Bursera graveolens</i>			
<i>Guapira floribunda</i>			X
<i>Erythrina velutina</i>			X
<i>Pithecellobium arboreum</i>			X
<i>Mutingia calabura</i>			X
<i>Xenostegia médium</i>		X	
<i>Cordia lutea</i>		X	
<i>Cynophalla flexuosa</i>		X	

Table 7 shows the categories of flora species according to whether they are cultivated, native, endemic, introduced or wild (Table 7).



Table 7. - Plants categorized according to their management category

Scientific name	C	N	E	I	S
<i>Mimosa acantholoba</i>					
<i>Pithecellobium arboreum</i>		X			
<i>Caesalpinia paipai</i>		X			
<i>Pithecellobium excelsum</i>		X			
<i>Geoffroea spinosa</i>		X			
<i>Erythrina velutina</i>		X			
<i>Prosopis pallida</i>		X			
<i>Vachellia macracantha</i>		X			
<i>Leucaena trichodes</i>		X			
<i>Jatropha curcas</i>	X			X	
<i>Croton rivinifolius</i>		X	X		
<i>Pisonia aculeata</i>		X			
<i>Guapira floribunda</i>					
<i>Bursera graveolens</i>		X			
<i>Muntingia calabura</i>		X			
<i>Trema micrantha</i>		X			
<i>Ceiba trichistandra</i>		X			
<i>Eriotheca ruizii</i>		X			
<i>Guazuma ulmifolia</i>		X			
<i>Cordia lutea</i>		X			
<i>Xenostegia médium</i>	X	X			
<i>Convolvulus arvensis</i>					X
<i>Ipomoea purpurea</i>					
<i>Acnitus arborencens</i>					
<i>Sarcomphalus thyrsoiflorus</i>		X			
<i>Coccoloba ruiziana</i>		X			X
<i>Vallesia glabra</i>		X			
<i>Cynophalla flexuosa</i>					
<i>Colicodendron scabridum</i>					
<i>Capparicordis crotonoides</i>					
<i>Bonellia sprucei</i>		X			

Note: C (cultivated); S (wild); E (endemic); I (introduced); N (native).



As detailed in the table above, most of the species are native to the Tropical Dry Forest, on the other hand, the species *Croton rivinifolius* is endemic to the Quimis area.

Shannon and Simpson Index (D)

According to the results, the diversity of species according to the Shannon index is classified as a high diversity in the area of the Quimis area, evidenced by the result obtained $H=4.2656$. In this same sense, *Cordia Lutea* species stand out; while *Pithecellobium arboreum* and *Vallesia glabra* present low dominance in the study area.

The results of the reciprocal of Simpson's Dominance (λ) = 0.06 and Simpson's $(1-\lambda) = 0.93$ show a high expectation for a random selection of two or more individuals of the same species in the established research area.

DISCUSSION

According to the results of the diversity of species inventoried in the Quimis enclosure through sampling it was found that these results differ with those obtained by *Aguilar et al., (2019)*, who reported 89 species, 39 families, and 2 394 individuals. Likewise, the results of the botanical species mentioned coincide with those reported by *(MAE 2013)*.

On the other hand, the IUCN reported the species *Croton rivinifolius* as endangered (EN), i.e. it has a high risk of extinction in the wild, which agrees with the reports of *Astudillo-Sánchez et al., (2019)*, while the species *Pithecellobium arboreum* is considered vulnerable (VU), being evaluated in 2020, as presented in the IUCN Red Book *(IUCN 2020)*. In this sense, both species face a risk of extinction or population decline in the medium term.

The species *Colicodendron scabridum* and *Bursera graveolens*, according to the IUCN Red Book, are categorized as LC (least concern), i.e. they are not critically endangered. On the other hand, *Carrillo (2015)* does not agree with the threat status of those two species, as he considers them to be categorized as critically endangered (CR).

According to the chorological classification of each species mentioned in the Quimis area, which was carried out with the aim of obtaining data on the structural characteristics of individuals, ie: root, stem, leaves, fruits, it was found that this coincides with that reported in other studies, such as those of *REDMIC (2019)*, which briefly ensure the concept of chorology as a study that occupies the area of distribution of organisms associated with the date of sampling or observation, in addition to introducing the species with the date of sampling in the locality indicated, other data of interest is incorporated, i.e., the depth, degree of uncertainty of the coordinates, reliability of the identification and location, author of the collection or observation, number of specimens and a field of notes where it can be commented on relevant information associated with the data. Other works with different results mention the elaboration and chorological classification from a single specimen *(Salas and Déniz, 2019)*.

The polliniferous and nectariferous species observed in the Quimis area, that in effect there are about 23 species of plants visited by the bees and that not only focus on the most common such as; the *Ceiba trichistandra* and *Prosopis pallida* that are the most



used by the beekeepers, if not that these travel around the other species that are in the forest; such as the rastrearas and the shrubs managing to obtain their own food.

On the other hand, [Insuasty, Martínez and Jurado \(2016\)](#), indicated that certain species can be used by *Apis mellifera* as alternative polliniferous resources, when there is a low availability of pollen contributing species around the apiaries, which coincides with this study.

Likewise, the species with the highest number of individuals was *Cordia lutea*, while *Vallesia glabra* presented the lowest number of individuals in relation to the data cited by [Jiménez et al., \(2017\)](#), who mentioned that these species have flowers useful for the production of pollen and honey due to their long flowering, aroma or chemical properties, among them: *Acacia macracantha*, *Terminalia valverdeae*, *Tabebuia chrysantha*, *Cordia lutea* and *Eriotheca ruizii*.

For continuity, it should be added that the Shannon index obtained with the data collected in Quimis reflects a high diversity of 4.26; differing from the analysis conducted by [Muñoz, Erazo and Armijos \(2014\)](#), in southwestern Ecuador who reported a value of 2.51 indicating a medium diversity. Similarly, Simpson's index showed a high dominance (S=0.93); similar to that reported by a study of the floristic composition and structure of the dry forests of the Province of Loja, Ecuador [Aguirre et al., \(2013\)](#), who reported a high dominance (S= 0.89).

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Authors' contribution:

Alfredo Jiménez González: Conception of the idea, instrument making, instrument application, statistic analysis, preparation of tables, graphs, and images, drafting of the original (first version), review and final version of the article, article correction, authorship coordinator, translation of terms or information obtained, review of the application of the applied bibliographic standard.

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