Analysis of morphological variation of *Magnolia rzedowskiana* A. Vázquez, R. Domínguez & R. Pedraza (Magnoliaceae) in the Sierra Madre Oriental, Mexico

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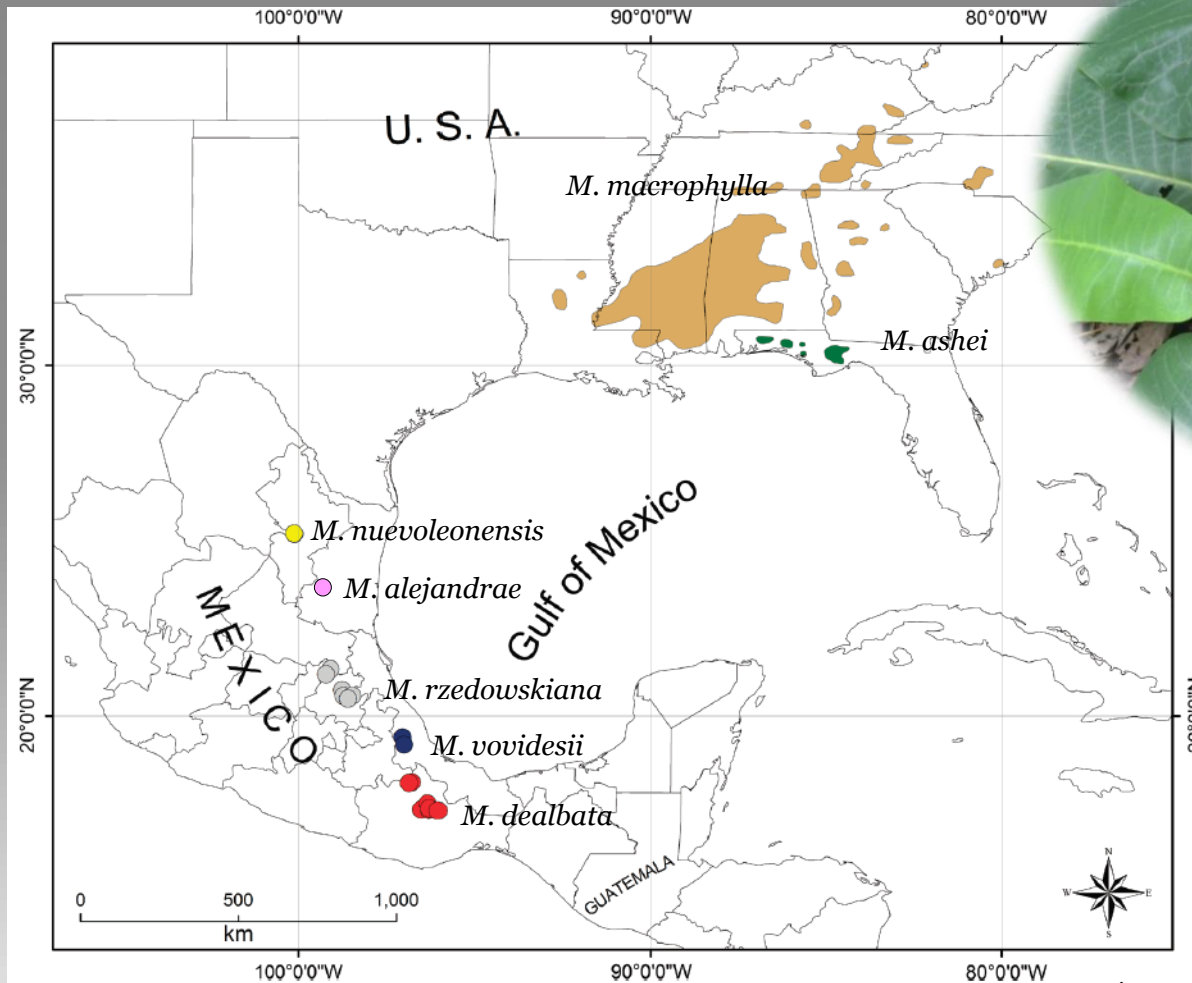
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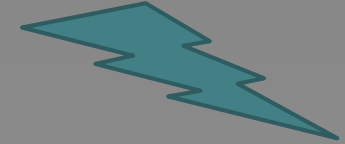
July, 2019

Introduction

- 350 **species** on the planet

- *Magnolia*: **170** species/**12** sections

- *Macrophylla*: deciduos leaves, petals with a purple stain

Vázquez-García *et al.* (2015), Sánchez-Velásquez, *et al.* (2016)

- Trees: 8-32 m

- Spiral pattern

  - Narrow petals

  - < Number of **stamens** y **carpels**

  - < Fruit size

Phenology: march-september

Gutiérrez y Vovides (1997), Vázquez-García *et al.* (2015)

Introduction

- ✓ *M. rzedowskiana*

- ✓ Endemic species
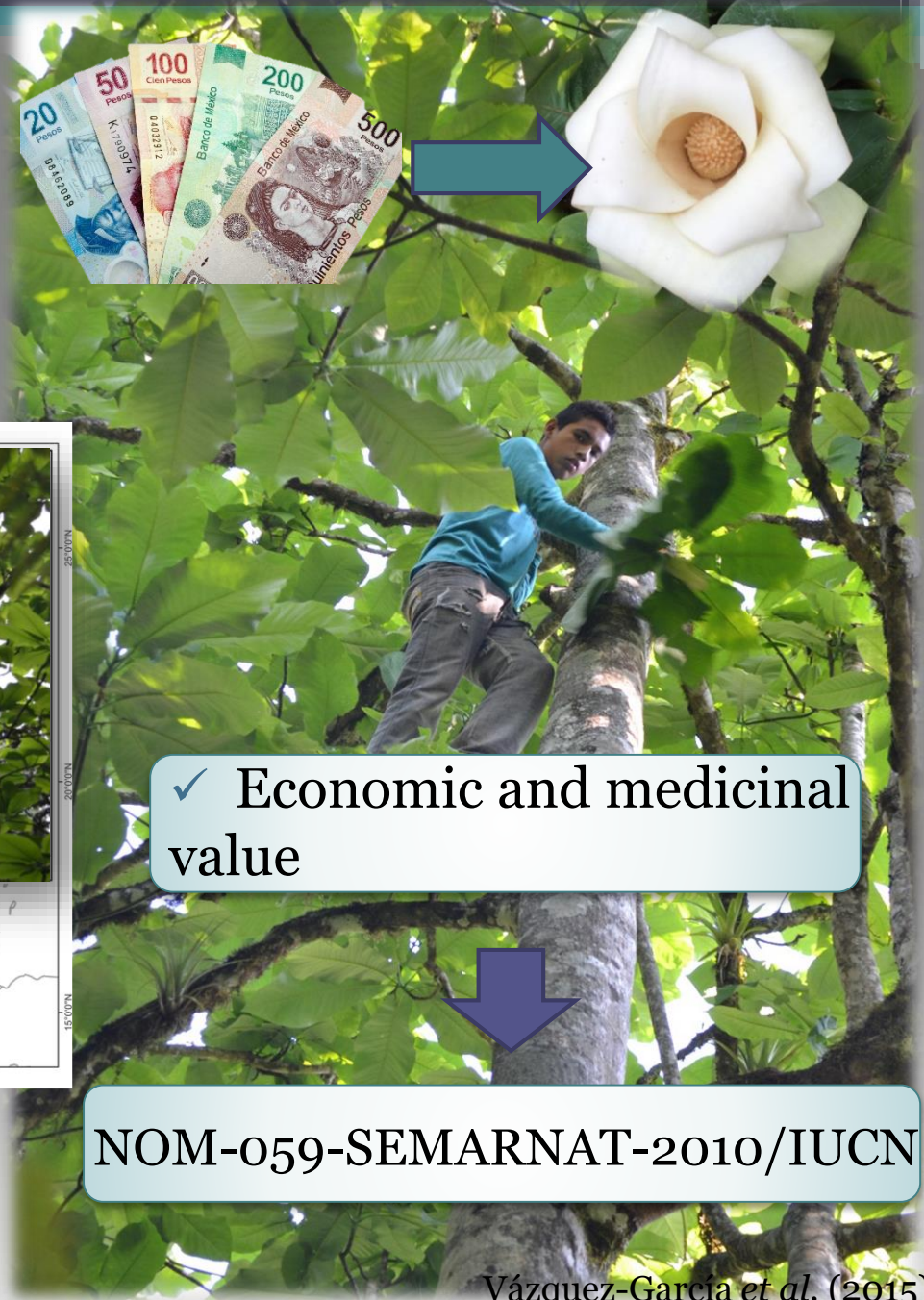
- ✓ Colud forest

- ✓ Economic and medicinal value

NOM-059-SEMARNAT-2010/IUCN

Vázquez-García *et al.* (2015)
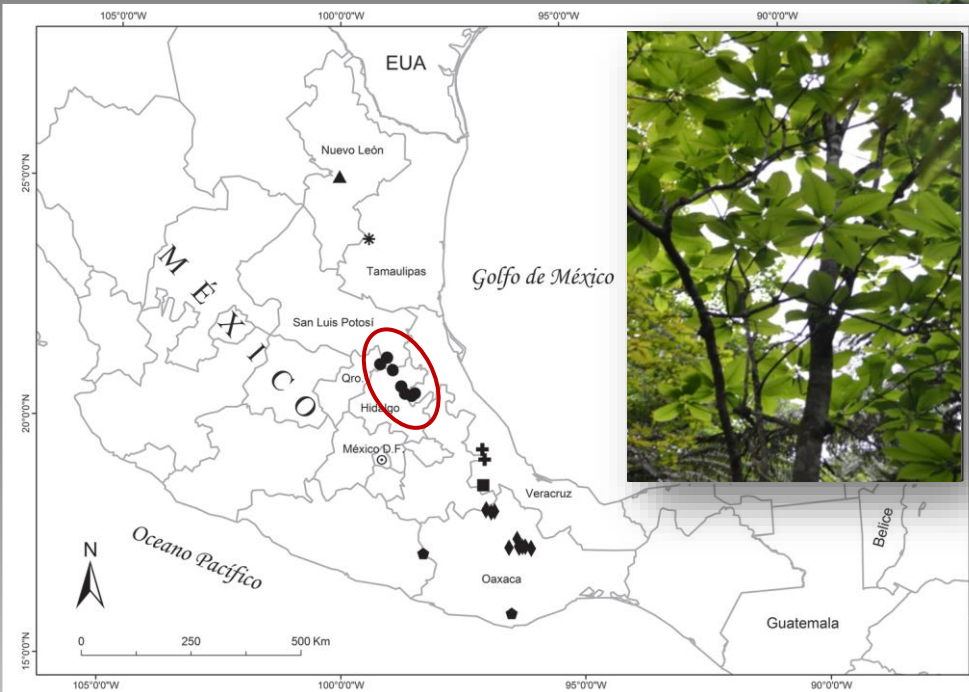
Background

Ecological studies

Molecular studies

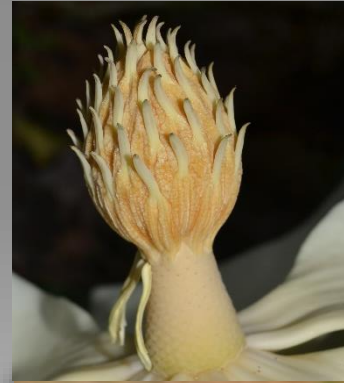**Taxonomic level**

MAGNOLIA RZEDOWSKIANA (MAGNOLIACEAE), UNA ESPECIE NUEVA DE LA SECCIÓN *MACROPHYLLA* DE LA PARTE CENTRAL DE LA SIERRA MADRE ORIENTAL, MÉXICO

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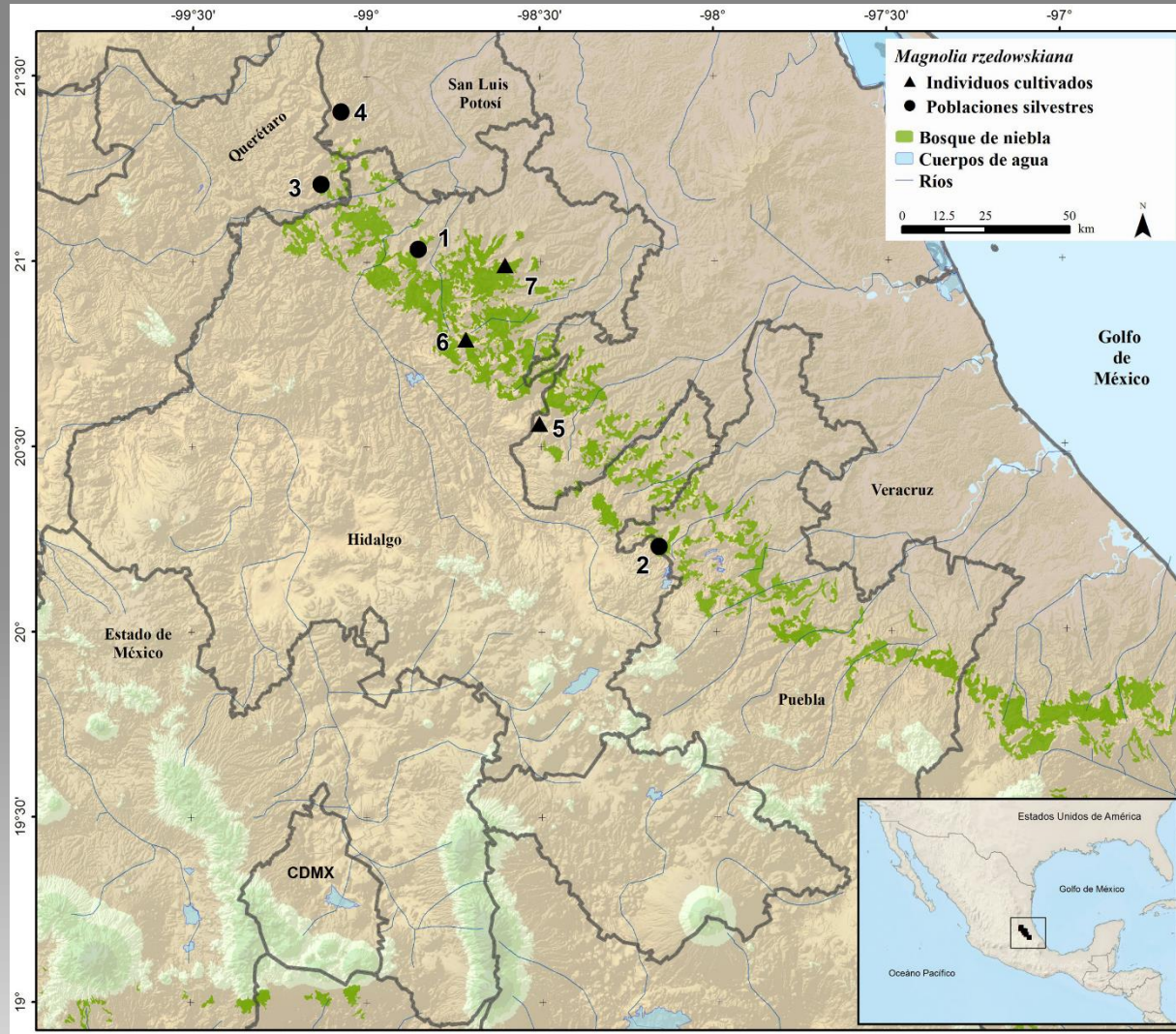
Objective

* **Know** the leaf and floral morphological variation of *M. rzedowskiana* of the Sierra Madre Oriental, Mexico
* **Provide** geographic and environmental information on the current state of their populations

Study area

✓ Colud forest

Toledo y Ordoñez (2009), Vázquez-García *et al.* (2015)

✓ High richness of plant species

Field and laboratory work

✓ April 2016-May 2017/ **18** field trips/**7** localities

Características generales de las localidades de estudio. *Nuevas localidades

Estado	Municipio	Localidad	Latitud	Longitud	Altitud
	Xochicoatlán	Acomulco	20° 47′31.5"	98° 42′55.4"	1823
	Tlanchinol	Apantlazol	20° 59′16.7"	98° 35′06.5"	1380
Hidalgo	Tepehuacán de Guerrero	Chilijapa*	21° 00′58"	98° 52′8.7"	1364
	Acaxochitlán	Zotictla*	20° 13′32.5"	98° 09′48"	1743
Veracruz	Huayacocotla	Agua de la Calabaza	21° 13′12.3"	99° 04′24.2"	1775
Querétaro	Landa de Matamoros	La Yesca	21° 13′04.3"	99° 07′53.2"	1716
San Luis Potosí	Xilitla	La Trinidad	21° 24′18.7"	99° 04′24.2"	1914

- ✓ 10 Individuals by location (4)

- ✓ 31 Characters: (13) foliar y (18) floral

- ✓ Height y DAP

5 flowers

10 Leaves
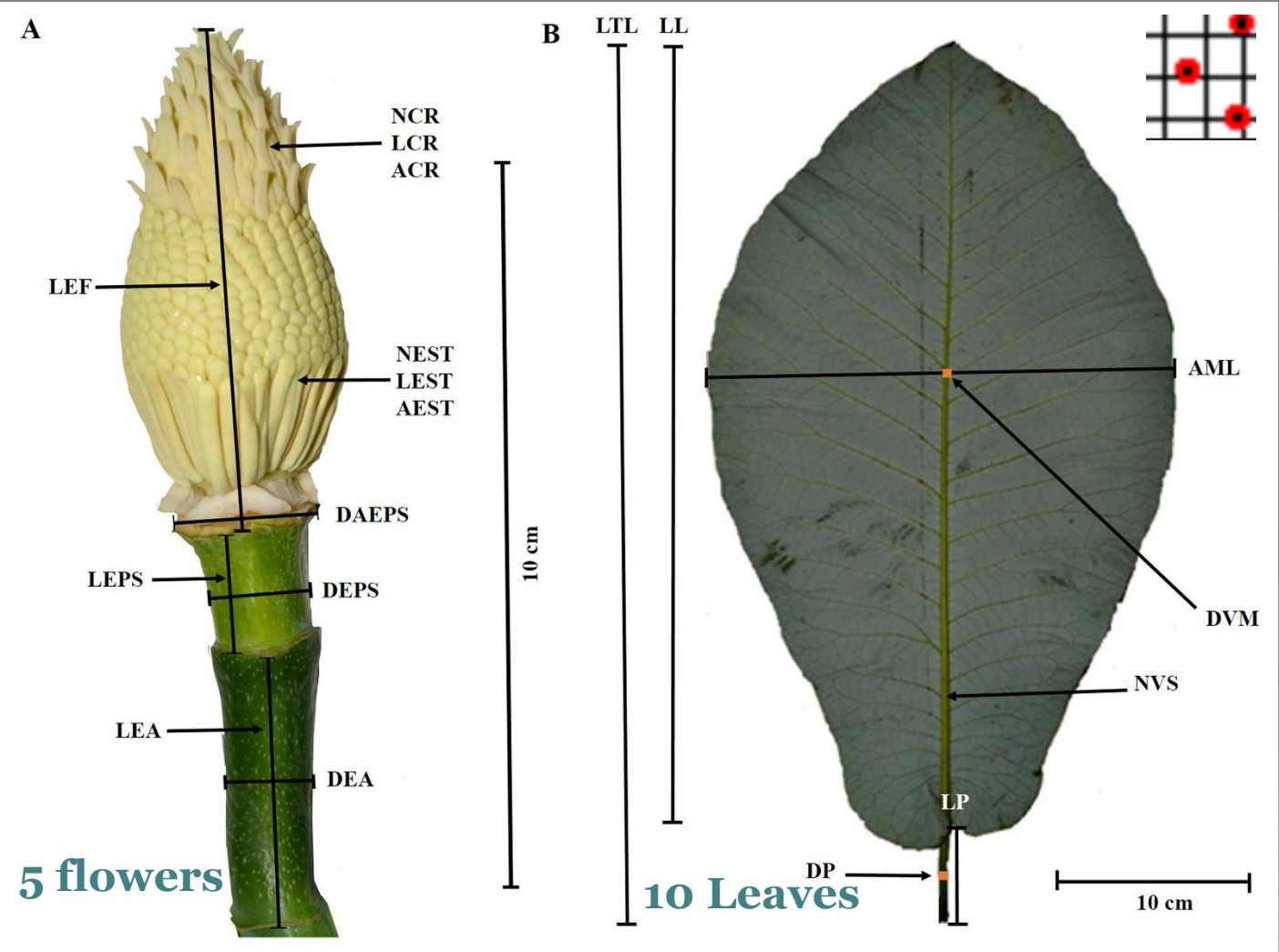
Canché-Delgado et al. (2011), Xin-Hua y Nian-He (2007), Jiménez-Ramírez et al. (2007), Vázquez-García et al. (2015)

Material and methods

✓ Statistic analysis

✓ Average
✓ Standard deviation
✓ Rank

✓ **Cluster analysis**

✓ CPA/Principal component analysis

✓ AFDG/Discriminat analysis

StatSoft (2004)

1,250 imágenes fotográficas

440 flowers

520 leaves

Diferencias morfológicas de las poblaciones de *Magnolia rzedowskiana*

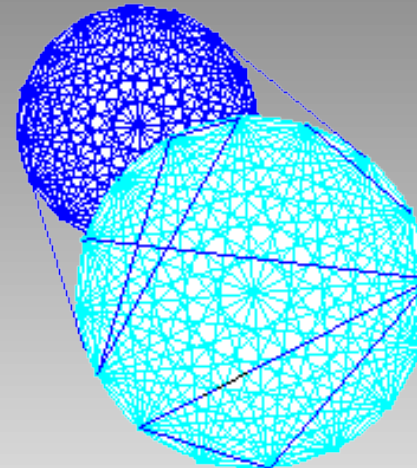|	Veracruz		Hidalgo			Querétaro	San Luis Potosí	*M. rzedowskiana*
	Agua de la Calabaza	Acomulco	Apantlazol	Chilijapa	Zotictla	La Yesca	La Trinidad	
1. Hábitat	Cultivados	Cultivados	Cultivados	BMM	BMM	BMM	BMM	BMM
2. Altitud	1775-1845	1823	1387-1492	1334-1424	1743-1869	1734-1797	1809-1929	1800-1950
3. Altura (m)	8.7(-16)	-	10.5 (-14)	18 (-32)	12.8 (-32)	13.4 (-22)	19.5 (-30)	(8-)10-20 (-25)
4. *D_{EPS} (cm)	1.49 (1.2-1.6)	1.37 (1.2-1.5)	1.33 (1.1-1.5)	1.41 (1.1-1.7)	1.78 (0.8-2.0)	1.24 (1.1-1.3)	1.44 (1.2-1.9)	-
5. *D_{AEPS} (cm)	2.15 (1.7-2.2)	1.85 (1.4-2.2)	1.73 (1.4-2.0)	1.84 (1.4-2.2)	2.58 (2.0-3.0)	1.91 (1.5-2.5)	2.0 (1.6-2.6)	-
6. *NCR	60 (49-67)	56 (48-64)	60 (54-67)	55 (42-67)	105 (89-127)	54 (40-73)	59 (46-82)	50-65
7. *NEST	359 (343-401)	393 (340-436)	333 (306-362)	383 (293-512)	429 (337-478)	287 (240-380)	301 (253-364)	290-310
8. *LP (cm)	8.7 (4.7-13.4)	10.2 (7.9-12)	9.9 (5.6-12.3)	9.6 (5.6-13)	6 (3.9-8.6)	10.5 (8.2-12.8)	9.3 (6.3-12.6)	-
9. *LL-AML	1.7 (1.3-2)	1.48 (1.4-1.9)	1.83 (1.5-2.0)	1.85 (1.5-2.2)	1.66 (1.3-1.9)	1.77 (1.5-1.9)	1.72 (1.4-1.9)	-
10. Fruto	Ovoide-romboidal	Ovoide-romboidal	Ovoide-romboidal 13.5-14	Ovoide-oblongoide a cónico 12-12.5	Ovoide-oblongoide subcónico 14-14.5	Ovoide-oblongoide a cónico 8.5-9.0	Ovoide-oblongoide a cónico 9.5-10	Ovoide-romboidal 9-10 × 4.5-6.0
11. Semilla	-	-	1.1 × 1.9 (-2)	1.6 × 1.9 (-2)	1.8 × 1.0 (-1.2)	-	1.1 × 1.7(-2)	1.1-1.5 × 0.6-0.7

*Caracteres que explicaron mayor porcentaje de variación y que fueron seleccionados en el análisis discriminante
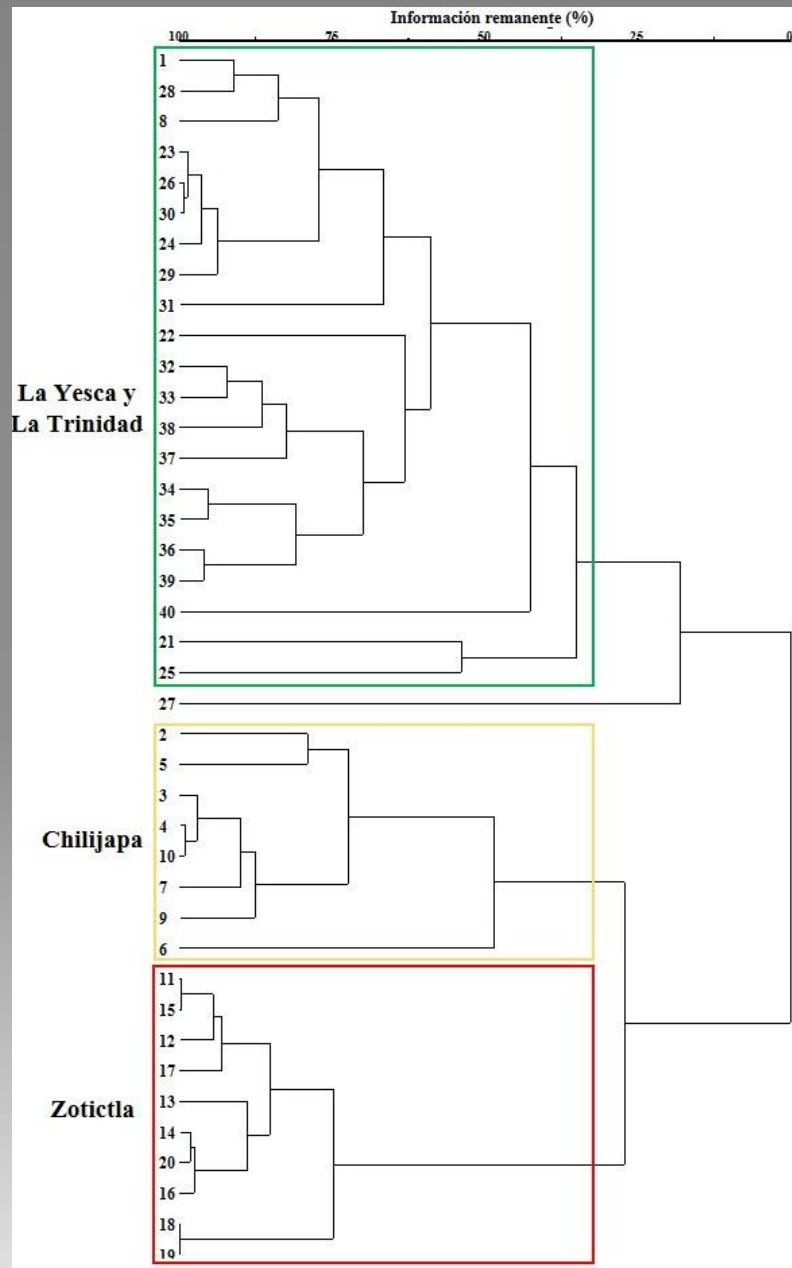
Results y discussion

Allowed us to **distinguish three different groups**, which correspond to the taxa analyzed

Zotictla: It has morphologically different individuals with respect to the other localities

Results and discussion

✓ **Principal component analysis**

Componente	1	2
Characteristc root	12.08	5.15
Explained variance (%)	38.96	16.63
Varianza cumulative (%)	38.96	55.60
Characteristics		
1. LEA	-0.57	0.53
2. DEA	**0.90***	0.03
3. LEPS	-0.12	-0.10
4. DEPS	**0.87***	-0.03
5. DAEPS	**0.85***	0.04
6. LSP	0.64	0.57
7. ASP	**0.71***	0.40
8. LPEX	-0.06	0.30
9. APEX	0.68	0.55
10. LPIN	0.67	0.48
11. APIN	0.68	0.43
12. LEF	**0.85***	0.11
13. NCR	**0.94***	-0.09
14. NEST	**0.80***	0.16
15. LCR	-0.67	0.06
16. ACR	-0.03	-0.23
17. LEST	0.05	0.46
18. AEST	-0.16	0.23
19. LTL	-0.68	0.66
20. LL	-0.57	**0.71***
21. LP	**-0.87***	0.42
22. DP	0.54	0.62
23. AML	-0.36	**0.76***
24. DVM	0.48	0.43
25. NVS	0.24	-0.01
26. LL-AML	-0.50	**0.74***
27. P%	**-0.88***	0.07
28. HW%	0.05	0.38
29. DW%	0.05	0.38
30. LL/AML	-0.49	0.09
31. LP/AML	**-0.86***	0.09

The first two components explain **55.66% of the variation** of the morphological characteristics

The shaded characters are the variables that explained the highest percentage in the data

Results y discussion

The first two canonical funtions explain 95.14% of the variation in the date

Variables	Canonical 1	Canonical 2	Lambda de Wilks	F
1. DEA	0.38	-0.46	0.91	0.77
2. DEPS	0.10	0.05	0.66	3.94**
3. DAEPS	0.38	0.55	0.69	3.50**
4. ASP	-0.43	-0.36	0.83	1.54
5. LEF	-0.52	0.22	0.85	1.35
6. NCR	**1.22**	0.54	0.50	7.73**
7. NEST	-0.25	**-1.31**	0.26	22.55**
8. LL	-1.96	-1.11	0.87	1.17
9. LP	-1.00	**1.06**	0.71	3.12**
10. AML	**2.75**	-0.47	0.95	0.39
11. LL-AML	1.02	**1.07**	0.60	5.33**
12. P%	**-1.72**	0.55	0.86	1.20
13. LP/AML	**2.95**	-1.48	0.93	0.58
Characteristic root	31.27	7.15	-	-
Variance (%)	77.69	95.14	-	-

Results y discussion

✓ Discriminant analysis
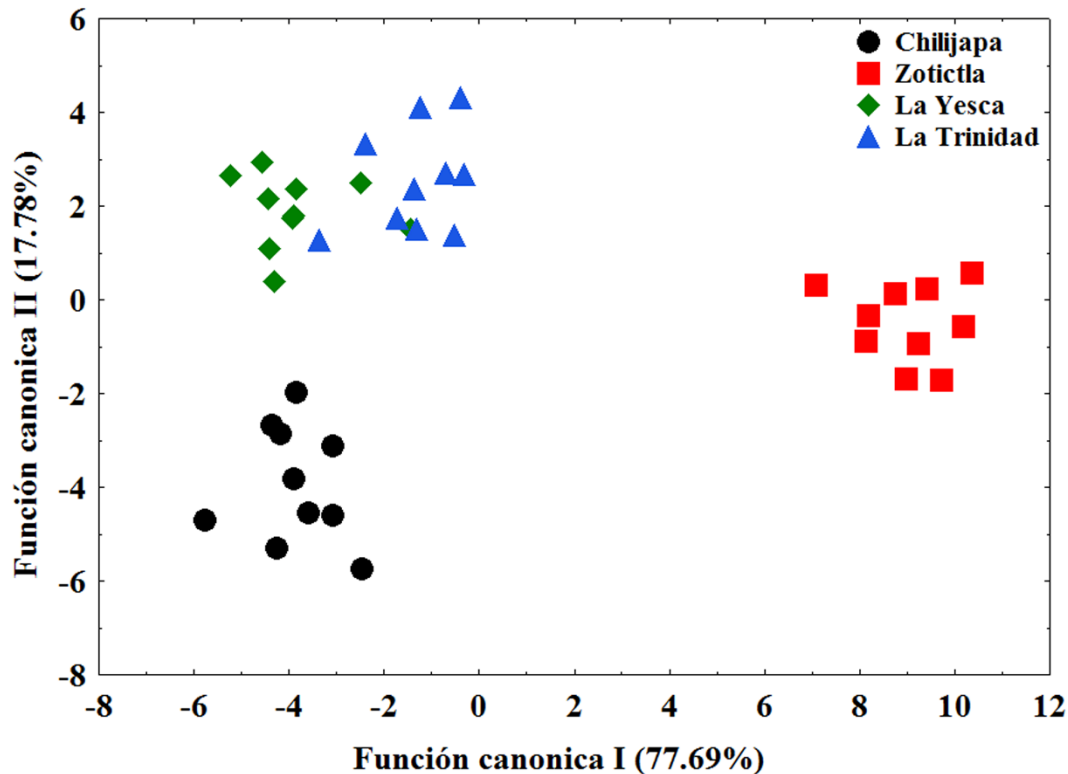
The grouping of the points is in agreement with the analyzed localities

Between The Yesca and La Trinidad there is a slight overlap

Distances from Mahalonobis indicate that the morphological variation between the localities is highly significant (p <0.01)

	Zotictla	The Yesca	The Trinidad
Chilijapa	177.62**	38.50**	50.29**
Zotictla	-	173.17**	120.59**
The Yesca		-	19.42**
The Trinidad			-

✓ **Anovas**

The population of Zotictla tends to form another group according to quantitative characteristics such as: **DEPS, DAEPS, NCR, NEST** y **LL-AML**
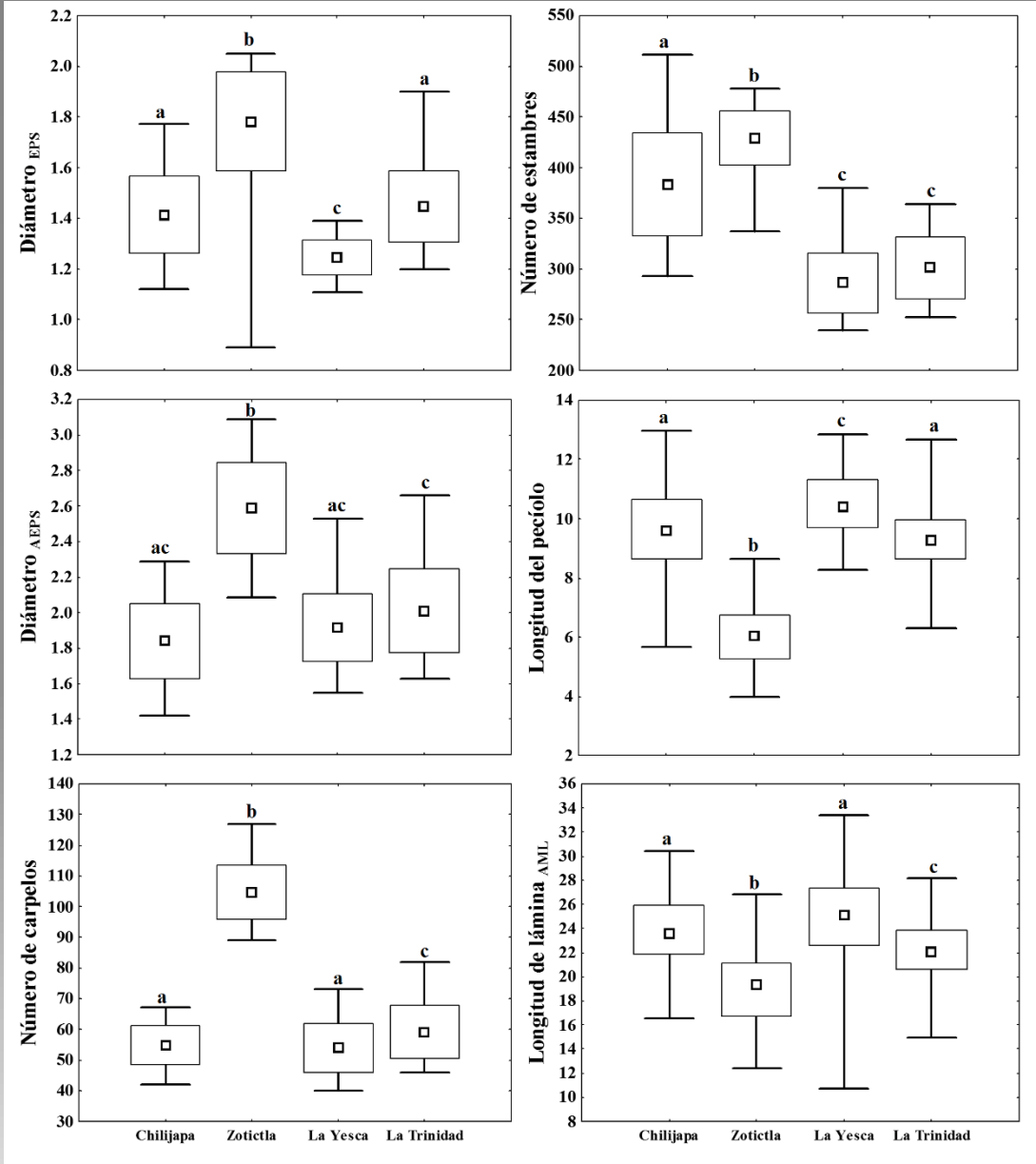
Results y discussion

Comparaciones morfológicas de las especies de *Magnolia* incluidas en la sección *Macrophylla* de México

	M. xxxxx	*M. dealbata*	*M. rzedowskiana*	*M. vovídesii*	*M. alejandrae*	*M. nuevoleonensis*
1. Altura de la planta (m)	12-32	15-21	8.7-32	8-25	8-16	15-20
2. Tamaño de las hojas	57-67 × 26-33	38-70 × 15-50	38-40 × 18-34	24-70 × 15-30	27-55 × 12-20	25-40 × 15-25
3. Diámetro de la flor	-	30-50	28-34	25-38	30-34	20-24
4. Tamaño del pétalo (cm)	11-18 × 6-11	15-22 × 8-10	14-16 × 5-7	12-18 × 6-7	14-17 × 5.5-8	10-11 × 3.5-7
5. Mancha del pétalo	Ausente	Presente	Ausente	Presente	Presente	Presente
6. Forma del gineceo	Ovoide	Oblongoide	Ovoide	Oblongoide-ovoide	Oblongoide- ovoide	Ovoide
7. Número de estambres	337-478	420-430	240-512	308-352	192-216	200-220
8. Longitud de los estambres (mm)	13-18	19-21	10-21	10-19	15-20	10-19
9. Tamaño del fruto (cm)	13-14.5 × 6.0-7.5	8-15 × 4.5-8	9-10 × 4.5-6.0	10-12 × 4.5-7.0	4.0-7.0 × 3.0-4.5	7.5-8.5 × 6.5-7.0
10. Forma del fruto	Ovoide-romboide	Ovoide-oblongoide-subcónica	Ovoide-romboide	Ovoide-oblongoide a cónico	Ovoide	Ovoide
11. Número de carpelos	89-127	80-105	40-82	60-78	42-52	30-42
12. Ápice de los carpelos	Prominente	Prominente	Prominente	Prominente	Prominente	Prominente
14. Longitud de las semillas (mm)	14-18 × 10-12	9-11	11-12 × 6-7	12 × 6-7	10-13 × 6-8	-
15. Hábitat	BMM	BMM	BMM	BMM	BMM	Bosque de pino-encino
16. Distribución	Hidalgo (Acaxochitlán)	Oaxaca	Veracruz, Hidalgo, Querétaro y San Luis Potosí	Veracruz	Tamaulipas	Nuevo León

Results and discussion

✓ The morphological similarity > The Yesca and The Trinidad with respect to the others, and the population of Zotictla is the most different

✓ The greatest foliar variation (**LP** and **LL-AML)** ⟹ **local environmental conditions** (Sultan y Spencer, 2002; Cavieres y Piper, 2004)

✓ The morphological characters of the flower **(NCR** and **NEST)** diagnostic characters (Berg, 1960; Brock y Weinig, 2007: Sánchez-Velázquez *et al.,* 2016)

✓ **Population** of **Zotictla** could be considered as a new species of the *Macrophylla* section

Conclusions

✓ There is wide leaf and floral morphological variation within and between populations= **phenotypic plasticity** and environmental conditions

✓ The identification of the foliar morphological characters such as **LP, LL-AML** and floral such as **DEPS, DAEPS, NCR** and **NEST**, are important characters that can allow differentiation between populations

✓ Population of **Zotictla**= new species

✓ **Human activities** and **natural disturbances** in some localities have caused the **decrease in population** (density a few hundred individuals) or a **extintion of wild populations** (Huayacocotla, Veracruz)

¡Thank you!

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