

Avifauna associated to a home garden in Valladolid, Yucatan, Mexico

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ABSTRACT

Objective: To identify the birds associated to a home garden in Valladolid, Yucatan, Mexico, and to understand which ones use cultivated plants as food.

Methodology: As part of the project “Fauna associated to cultivated plants in the south-southeast region of Mexico”, 36 field visits were carried out, for six hours per day (6:00-10:00 and 16:00-18:00 hrs.), in the period from March 2022 to April 2023, in a home garden in Valladolid, Yucatan. The birds were watched with binoculars, photographed with digital cameras, and identified with field guides.

Results: A total of 67 bird species were observed, which belonged to 14 orders and 28 families. Of the species, 14 are migratory, three endemic, and four subject to special protection in Mexico. In addition, 21 bird species were found feeding off 22 species of cultivated plants. The most frequently used plant resource by the birds were fruits (16), followed by nectar (5) and tender leaves (1). The most consumed plants species by the birds were *Manilkara zapota* (L.) P. Royen, *Carica papaya* L. and *Spondias purpurea* L., which were used by three bird species each. The bird that consumed more cultivated plants was the Golden-fronted Woodpecker (*Melanerpes aurifrons* Wagler) that fed off five species.

Limitations on study: It was not possible to identify two birds at the species level: *Contopus* sp. and *Myiarchus* sp.

Conclusions: This study contributes to the knowledge of birds associated to home gardens and constitutes the basis for future studies on bird-plant trophic interactions in Mexico.

Keywords: Birds, home garden, Valladolid, Yucatán, Mexico.

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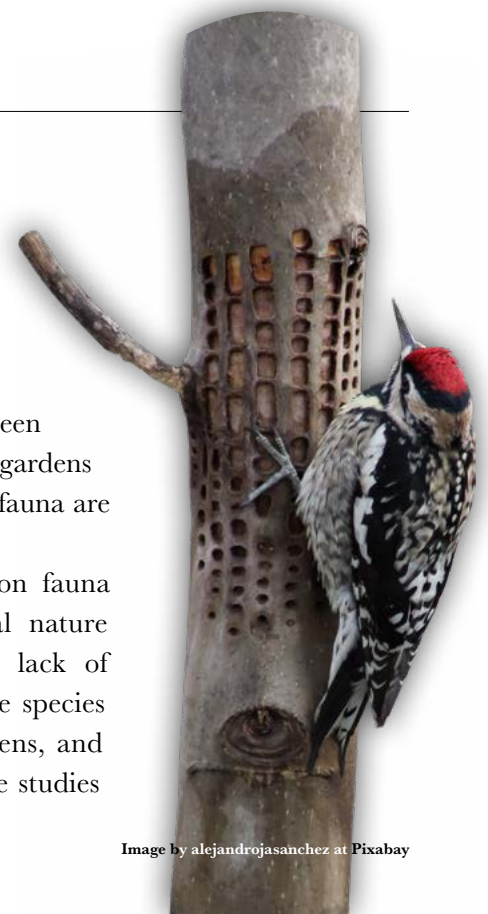
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INTRODUCTION

Home gardens are complex agroforestry systems, of sociocultural and environmental importance, which combine agricultural and livestock production with conservation of flora and fauna (Guadarrama-Martínez and Chávez-Mejía, 2023). In the southeast of Mexico many studies have been conducted about the floristic composition of home gardens (Castañeda-Navarrete *et al.*, 2018), yet studies on wild fauna are scarce (Mariaca-Méndez, 2012).

In the Yucatan Peninsula, most of the studies on fauna associated to home gardens are of ethnobiological nature (Barranco-Vera *et al.*, 2023); however, there is a lack of studies with direct methods to allow determining the species of the different groups of fauna present in the gardens, and the way in which they relate to the vegetation. These studies



are particularly important for birds, because they can find sites for nesting, refuge and feeding in home gardens (Sánchez-Soto, 2018). In addition, with studies of this nature, potentially damaging species for some crops can be detected (Sánchez-Soto, 2016). Therefore, the objective was to identify the species of wild birds associated with a home garden in Valladolid, Yucatan, Mexico, and to understand which could use cultivated plants as a feeding resource.

MATERIALS AND METHODS

Study area

The study was conducted in a home garden of 0.5 ha, approximately 50 years old, located in the city of Valladolid, Yucatan, Mexico (20° 41' 22" N and 88° 12' 6" W), 400 m away from the Central Park, 15 m away from the "San Juan" sports center, and 60 m away from the private school "Centro de Enseñanza Siglo XXI" in that city. It neighbors a portion of secondary vegetation of approximately 70 m² and another of 2.0 ha, separated by an avenue. The climate is predominantly warm subhumid with summer rains and the mean annual temperature is 25.8 °C (Orellana-Lanza *et al.*, 2010). The geomorphology of the area is constituted by an undulating plain of carstic nature (Bautista-Zúñiga *et al.*, 2010), which favors water infiltration forming caves inside the garden. The soil is Luvisol and Cambisol (García-Gil *et al.*, 2010) and the original vegetation was constituted by medium sub-deciduous forest (Flores-Guido *et al.*, 2010).

The garden was made up by native and exotic plants. The timber-yielding native trees included chechén (*Metopium brownie* (Jacq.) Urb.), chaká (*Bursera simaruba* (L.) Sarg.), cedar (*Cedrela odorata* L.), maya nut (*Brosimum alicastrum* Sw.), and dyer's mulberry (*Maclura tinctoria* (L.) D. Don ex Steud). The native fruit trees, chirimoya (*Annona reticulata* L.), saramuyo (*Annona squamosa* L.), sapodilla (*Manilkara zapota* (L.) P. Royen), caimito (*Chrysophyllum mexicanum* Brandegees ex Standl), plum (*Spondias purpurea* L.), guava (*Psidium guajava* L.), sour sop (*Annona muricata* L.), and papaya (*Carica papaya* L.). The exotic fruit trees, bitter orange (*Citrus aurantium* L.), sweet orange (*Citrus sinensis* (L.) Osbeck), Persian lime (*Citrus latifolia* Tanaka Ex Q. Jiménez), mandarin (*Citrus reticulata* Blanco), coconut (*Cocos nucifera* L.), banana (*Musa paradisiaca* L.), tamarind (*Tamarindo indica* L.), and mango (*Mangifera indica* L.). The native ornamental, sabal (*Sabal yapa* C. Wright ex Becc.), yellow oleander (*Cascabela thevetia* (L.) Lippold) and wax mallow (*Malvaviscus arboreus* Cav.); and the exotic, African tulip tree (*Spathodea campanulata* P. Beauv.), bougainvillea (*Bougainvillea glabra* Choisy) and neem (*Azadirachta indica* A. Juss.).

Edible, medicinal and honey horticultural species included chili (*Capsicum annum* L.), epasote (*Dysphania ambrosioides* (L.) Mosyakin & Clemants), momo (*Piper auritum* Kunth), purple maguey (*Tradescantia spathacea* Sw.) and palo de caja (*Allophylus cominia* (L.) Sw.).

In general, in the garden there were one to four plants per species, except for bitter orange of which there were around 10 plants.

Bird registration

Registration of birds associated to the home garden was carried out from April 2022 to March 2023, avoiding the days with strong rainfall or winds (Bibby *et al.*, 2002). During

this period, 36 daily visits were made, of six hours per day (6:00-10:00 and 16:00-18:00 hrs.), representing 216 h of observations. In each visit, linear visits were made that covered the entire garden.

The birds were observed with binoculars (Bushnell 10×50) and photographed with a digital camera (Canon EOS Rebel T7 with 75-300mm lens). For identification of the species, the field guides by Howell and Webb (1995), Peterson and Chalif (1989), and Van Perlo (2006) were used. The taxonomic nomenclature and the common names were taken from the study by Berlanga-García *et al.* (2019). Each species was assigned a category of habitat preference and trophic guild based on Howell and Webb (1995) and Arriaga (2008).

RESULTS AND DISCUSSION

During the study period, 67 bird species were recorded associated to the garden, from 28 families and 14 orders. Of these, 53 are resident and 14 are migratory; 4 species are subject to special protection, 3 are endemic, and 2 exotic (Table 1). The number of species recorded is equivalent to 15% of the total birds reported for the state of Yucatan (Chablé-Santos and Pasos-Enríquez, 2010).

This number is considerable compared to the 22 species reported by Montañez-Escalante *et al.* (2012), the 11 species mentioned by Heredia-Campos (2020), and the 4 mentioned by Barranco-Vera *et al.* (2023) in ethnobiological studies carried out in different home gardens of the state of Yucatan, since this study was focused especially on this group of vertebrates through direct observations. In this sense, this number is similar to the number of species (70) registered by Sánchez-Soto (2018) in a home garden located in a suburban area in the state of Tabasco, also located in the southeast of Mexico.

The families with the highest number of species are Icteridae with 9, Tyrannidae with 6, Parulidae with 5, and Columbidae with 5 (Figure 1), which are equivalent to 22% of the total species from these families reported for Yucatan (Chablé-Santos and Pasos-Enríquez, 2010). Likewise, most of the species were forest generalist (FG) (64%); that is, they tolerate conditions of habitat disturbance (Howell and Webb, 1995; Arriaga, 2008), followed by open area specialists (OA) (31%) which require open or semi-open habitats such as forest edges, clearings and even towns and urban areas (Howell and Webb, 1995; Arriaga, 2008), and to a lesser degree there were forest specialists (FS) which are particularly more sensitive to fragmentation and naturally more difficult to observe (Turner, 1996; Arriaga, 2008) (Figure 2).

It is possible that the abundance of FG and OA species is due to the heterogeneity of the habitat (Arriaga, 2008), composed by the urban matrix, the patches of secondary vegetation, and the home garden; therefore, this agroforestry system seems to provide connectivity, refuge and food to the FG and OA species, although it lacks adequate resources for FS species that are more sensitive and which require portions of landscape that are not altered by human activity (Barret *et al.*, 1994).

The predominant food guild was arboreal insectivore/frugivore with 15 species (22%), followed by sallying/sweeping insectivore with 9 species (13%), and foliage-gleaning insectivore with 8 species (12%) (Figure 3).

Table 1. Birds recorded in a home garden in Valladolid, Yucatan, Mexico.

Order and Family	Scientific name	Common name	H	TG	S
Galliformes					
Cracidae	<i>Ortalis vetula</i> (Wagler, 1830)	Plain Chachalaca	FG	AF	R
Columbiformes					
Columbidae	<i>Columba livia</i> (Gmelin, 1789) ¹	Rock Pigeon	OA	GR	R
	<i>Streptopelia decaocto</i> (Frisvoldszky, 1838) ¹	Eurasian Collared-Dove	OA	GR	R
	<i>Columbina passerina</i> (Linnaeus, 1758)	Common Ground Dove	OA	GR	R
	<i>Columbina talpacoti</i> (Temminck, 1810)	Ruddy Ground Dove	OA	GR	R
	<i>Zenaida asiatica</i> (Linnaeus, 1758)	White-winged Dove	FG	GR	RM
Cuculiformes					
Cuculidae	<i>Crotophaga sulcirostris</i> (Swainson, 1827)	Groove-billed Ani	OA	TI	R
	<i>Piaya cayana</i> (Linnaeus, 1766)	Squirrel Cuckoo	FG	FI	R
Nyctibiiformes					
Nyctibiidae	<i>Nyctibius jamaicensis</i> (Gmelin, 1789)	Northern Potoo	FG	SwI	R
Apodiformes					
Apodidae	<i>Chaetura vauxi</i> (Townsend, 1839)	Vaux's Swift	OA	SwI	R
Trochilidae	<i>Cyananthus canivetii</i> (Lesson, 1832)	Canivet's Emerald	FG	NI	R
	<i>Amazilia rutila</i> (DeLattre, 1842)	Cinnamon Hummingbird	FG	NI	R
Cathartiformes					
Cathartidae	<i>Coragyps atratus</i> (Bechstein, 1793)	Black Vulture	OA	SC	R
	<i>Cathartes aura</i> (Linnaeus, 1758)	Turkey Vulture	OA	SC	R
Accipitriformes					
Accipitridae	<i>Rupornis magnirostris</i> (Gmelin, 1788)	Roadside Hawk	OA	R	R
	<i>Buteo albonotatus</i> (Kaup, 1847)	Zone-tailed Hawk	OA	R	M
Strigiformes					
Tytonidae	<i>Tyto alba</i> (Scopoli, 1769)	Barn Owl	FG	R	R
Strigidae	<i>Glaucidium brasilianum</i> (Gmelin, 1788)	Ferruginous Pygmy-Owl	FG	R	R
Trogoniformes					
Trogonidae	<i>Trogon melanocephalus</i> (Gould, 1836)	Black-headed Trogon	FG	AF	R
Coraciiformes					
Momotidae	<i>Momotus lessonii</i> (Lesson, 1842)	Lesson's Motmot	FG	AIF	R
	<i>Eumomota superciliosa</i> (Sandbach, 1837)	Turquoise-browed Motmot	FG	AIF	R
Piciformes					
Picidae	<i>Melanerpes pygmaeus</i> (Ridgway, 1885) ²	Yucatan Woodpecker	FG	BI	R
	<i>Melanerpes aurifrons</i> (Wagler, 1829)	Golden-fronted Woodpecker	FG	BI	R
	<i>Dryocopus lineatus</i> (Linnaeus, 1766)	Lineated Woodpecker	FG	SI	R
Falconiformes					
Falconidae	<i>Falco sparverius</i> (Linnaeus, 1766)	American Kestrel	OA	R	M
	<i>Falco ruficularis</i> (Daudin, 1800)	Bat Falcon	FG	R	R
Psittaciformes					
Psittacidae	<i>Eupsittula nana</i> (Vigors, 1830) ^{3, 4}	Olive-throated Parakeet	FG	AF	R
	<i>Amazona albifrons</i> (Sparrman, 1788) ³	White-fronted Parrot	FG	AF	R

Table 1. Continues...

Order and Family	Scientific name	Common name	H	TG	S
Passeriformes					
Tityridae	<i>Tityra semifasciata</i> (Spix, 1825)	Masked Tityra	FG	SI	R
	<i>Pachyrhamphus aglaiae</i> (Lafresnaye, 1839)	Rose-throated Becard	FS	SI	R
Tyrannidae	<i>Myiarchus</i> sp. (Cabanis, 1844)	Flycatcher	FG	SI	R
	<i>Pitangus sulphuratus</i> (Linnaeus, 1766)	Great Kiskadee	FG	SI	R
	<i>Megarynchus pitangua</i> (Linnaeus, 1766)	Boat-billed Flycatcher	FG	SI	R
	<i>Myiozetetes similis</i> (Spix, 1825)	Social Flycatcher	FG	SI	R
	<i>Tyrannus melancholicus</i> (Vieillot, 1819)	Tropical Kingbird	FG	SI	R
	<i>Contopus</i> sp. (Cabanis, 1855)	Pewee	FG	SI	R
Vireonidae	<i>Vireo griseus</i> (Boddaert, 1783)	White-eyed Vireo	FG	FI	M
	<i>Vireo pallens</i> (Salvin, 1863) ³	Mangrove Vireo	FG	UI	R
Corvidae	<i>Cyanocorax yncas</i> (Boddaert, 1783)	Green Jay	FG	AIF	R
	<i>Cyanocorax yucatanicus</i> (Dubois, 1875) ²	Yucatan Jay	FG	AIF	R
Troglodytidae	<i>Troglodytes aedon</i> (Vieillot, 1809)	House Wren	FG	UI	R
Poliopitilidae	<i>Polioptila caerulea</i> (Linnaeus, 1766)	Blue-gray Gnatcatcher	FG	FI	R
Turdidae	<i>Turdus grayi</i> (Bonaparte, 1838)	Clay-colored Thrush	FG	TI	R
Mimidae	<i>Dumetella carolinensis</i> (Linnaeus, 1766)	Gray Catbird	OA	UI	M
	<i>Mimus gilvus</i> (Vieillot, 1808)	Tropical Mockingbird	FG	FI	R
Fringillidae	<i>Euphonia affinis</i> (Lesson, 1842)	Scrub Euphonia	FG	AF	R
Icteridae	<i>Amblycercus holosericeus</i> (Deppe, 1830)	Yellow-billed Cacique	FG	AIF	R
	<i>Icterus spurius</i> (Linnaeus, 1758)	Orchard Oriole	FG	AIF	M
	<i>Icterus cucullatus</i> (Swainson, 1827)	Hooded Oriole	FG	AIF	R
	<i>Icterus auratus</i> (Bonaparte, 1850) ²	Orange Oriole	FG	AIF	R
	<i>Icterus gularis</i> (Wagler, 1829)	Altamira Oriole	FG	AIF	R
	<i>Icterus galbula</i> (Linnaeus, 1758)	Baltimore Oriole	OA	AIF	M
	<i>Molothrus aeneus</i> (Wagler, 1829)	Bronzed Cowbird	OA	TI	R
	<i>Dives dives</i> (Deppe, 1830)	Melodious Blackbird	OA	AIF	R
	<i>Quiscalus mexicanus</i> (JF Gmelin, 1788)	Great-tailed Grackle	OA	O	R
Parulidae	<i>Mniotilta varia</i> (Linnaeus, 1766)	Black-and-white Warbler	FG	AIF	M
	<i>Setophaga petechia</i> (Linnaeus, 1766)	Yellow Warbler	OA	FI	MR
	<i>Setophaga coronata</i> (Linnaeus, 1766)	Yellow-rumped Warbler	OA	FI	M
	<i>Setophaga dominica</i> (Linnaeus, 1766)	Yellow-throated Warbler	OA	FI	M
	<i>Setophaga virens</i> (Gmelin, 1789)	Black-throated Green Warbler	OA	FI	M
Cardinalidae	<i>Piranga rubra</i> (Linneo, 1758)	Summer Tanager	OA	AIF	M
	<i>Habia fuscicauda</i> (Cabanis, 1861)	Red-throated Ant-Tanager	FS	UI	R
	<i>Passerina caerulea</i> (Linneo, 1758)	Blue Grosbeak	OA	GR	M
Thraupidae	<i>Thraupis episcopus</i> (Linnaeus, 1766)	Blue-gray Tanager	FG	AF	R
	<i>Thraupis abbas</i> (Deppe, 1830)	Yellow-winged Tanager	FG	AF	R
	<i>Eucometis penicillata</i> (Spix, 1825) ³	Gray-headed Tanager	FS	AIF	R
	<i>Saltator grandis</i> (Deppe, 1830)	Black-headed Saltator	FG	AIF	R

Abbreviations. H: Habitat Preference (FG: Forest Generalist, OA: Open Area Specialist, FS: Forest Specialist). G: Guilds (AF: Arboreal Frugivore, GR: Granivore, TI: Terrestrial Insectivore, FI: Foliage-Gleaning Insectivores, SwI: Sweeping Insectivore, NI: Nectarivore/Insectivore, SC: Scavenger, R: Raptor, AIF: Arboreal Insectivore/Frugivore, SI: Sallying/Sweeping Insectivore, BI: Bark-Gleaning Insectivore, UI: Undergrowth Insectivore, O: Omnivore). S: Status (R: Resident, M: Migratory) (Howell y Webb, 1995; Arriaga, 2008). ¹Exotic, ²Endemic (Berlanga et al., 2019), ³Subject to Special Protection (SEMARNAT, 2010), ⁴Near Threatened (UICN, 2020).

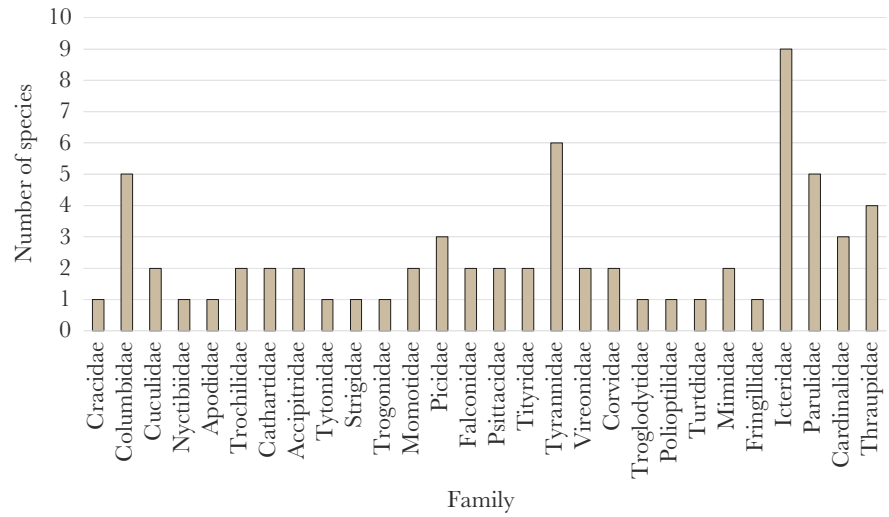


Figure 1. Species composition by family of a bird community in a home garden in Valladolid, Yucatan, Mexico.

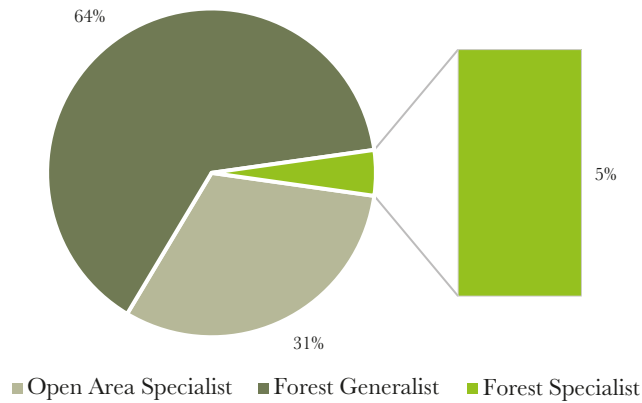


Figure 2. Proportion of habitat preference in a bird community in a home garden in Valladolid, Yucatan, Mexico.

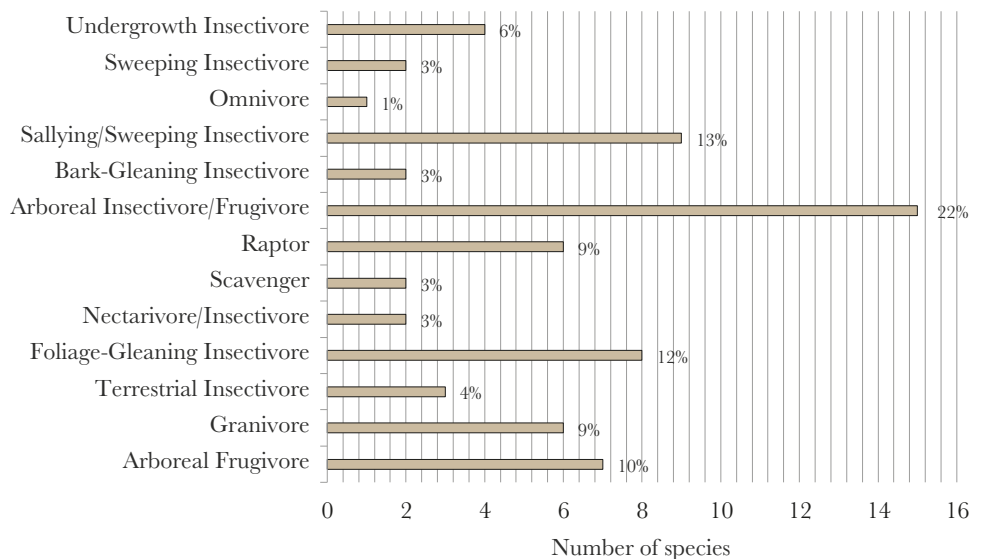


Figure 3. Proportion of food guilds in a bird community of a home garden in Valladolid, Yucatan, Mexico.

It is likely that the abundance of these categories of insectivores is because the diversity of trees in the garden regulates the entry of light and generates microclimates that allow the diversification of arthropods (Basset *et al.*, 1992; Van Der Wal *et al.*, 2019).

In total, 21 bird species were seen feeding off 22 cultivated plants (Figure 4). The most frequently used plant resource used by the birds was fruits (16), followed by nectar (5) and tender leaves (1). The most consumed plants by the birds were sapodilla (*M. zapota*), papaya (*C. papaya*) and plum (*S. purpurea*), consumed by 3 bird species each (Figure 4). These native fruit trees are considered “structural” species in home gardens in Yucatan, since together with other woody plant species, they provide the most plant cover and give structure to these agroecosystems (Montañez-Escalante *et al.*, 2012).

The bird that consumed the most cultivated plants was the Golden-fronted Woodpecker (*Melanerpes aurifrons* Wagler), which was observed feeding off five fruit tree species: chirimoya (*A. reticulata*), saramuyo (*A. squamosa*), papaya (*C. papaya*), tamarind (*T. indica*) and sweet orange (*C. sinensis*). The latter was consumed 11 times during the study period (Figure 5), so the bird is considered a pest by the garden owners. The Golden-fronted Woodpecker (*M. aurifrons*) has been observed feeding off other crops in the southeast of Mexico, such as cacao (*Theobroma cacao* L.) where losses of up to 5% have been reported (Arriaga, 1985); therefore, the suggestion is to perform studies to evaluate the damages that it causes in citrus trees of the home gardens in Valladolid, Yucatan. However, this bird has traditionally been classified as an insectivore bark species, similar to the Yucatan

		01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22
		<i>Manilkara zapota</i>	<i>Hibiscus rosa-sinensis</i>	<i>Malvaviscus arboreus</i>	<i>Cascabela thevetia</i>	<i>Carica papaya</i>	<i>Spondias purpurea</i>	<i>Citrus reticulata</i>	<i>Annona reticulata</i>	<i>Annona squamosa</i>	<i>Tamarindus indica</i>	<i>Citrus sinensis</i>	<i>Capsicum annuum</i>	<i>Sabal yapa</i>	<i>Allophylus cominia</i>	<i>Spathodea campanulata</i>	<i>Bougainvillea glabra</i>	<i>Musa paradisiaca</i>	<i>Azadirachta indica</i>	<i>Cedrela odorata</i>	<i>Psidium guajava</i>	<i>Cecropia obtusifolia</i>	<i>Maclura tinctoria</i>
<i>Ortalis vetula</i>	1	F																					
<i>Cyananthus canivetii</i>	2		N																				
<i>Amazilia rutila</i>	3			N	N																		
<i>Melanerpes pygmaeus</i>	4	F					F	F															
<i>Melanerpes aurifrons</i>	5					F			F	F	F	F											
<i>Myiozetetes similis</i>	6											F											
<i>Cyanocorax yucatanicus</i>	7												F										
<i>Turdus grayi</i>	8	F																					
<i>Dumetella carolinensis</i>	9													F									
<i>Amblycercus holosericeus</i>	10									F													
<i>Icterus spurius</i>	11															N							
<i>Icterus cucullatus</i>	12				N		F																
<i>Icterus auratus</i>	13															N	N						
<i>Icterus gularis</i>	14					F	F																
<i>Icterus galbula</i>	15																						
<i>Dives dives</i>	16					F											F						
<i>Piranga rubra</i>	17																		F	F			
<i>Quiscalus mexicanus</i>	18																	F					
<i>Thraupis episcopus</i>	19																				F		
<i>Thraupis abbas</i>	20																					F	
<i>Saltator grandis</i>	21											L									F		F

Abbreviations: F: Fruits, N: Nectar, L: Leaves

Figure 4. Matrix of trophic interactions: bird-plant in a home garden in Valladolid, Yucatan, Mexico.



Figure 5. Damage on sweet orange (*Citrus sinensis*) by the Golden-fronted Woodpecker (*M. aurifrons*) in a home garden in Valladolid, Yucatan, Mexico.

Woodpecker (*Melanerpes pygmaeus* Ridgway) which was seen in this study feeding off 3 species of cultivated plants: sapodilla, plum and mandarin (Figure 4). Therefore, the suggestion is to analyze the trophic guilds and to ratify them with direct observations and not solely based on the literature, since as López-Muñoz *et al.* (2022) mention, sometimes birds are grouped under a single criterion, such as their main source of food, leaving aside their other foraging techniques and other resources.

CONCLUSIONS

The number of birds (21) that feed off cultivated plants is considerable, since it represents 31% of the total birds observed (67), and is higher than the percentage (24%) of species recorded by Sánchez-Soto (2018) consuming cultivated plants in a home garden in Tabasco. These data indicate that home gardens in Valladolid, Yucatán, provide resources to an important number of wild birds. It should be highlighted that with the exception of Golden-fronted Woodpecker (*M. aurifrons*), the other species do not seem to represent a threat for cultivated plants, since they were not observed causing considerable damage.

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REFERENCES

1. Guadarrama-Martínez, N., & Chávez-Mejía, M.C. (2023). Factores sociales y culturales que favorecen la riqueza de frutales en huertos familiares. *Agricultura, Sociedad y Desarrollo*. 20(4): 425-438. doi: 10.22231/asyd.v20i4.1530
2. Castañeda-Navarrete, J., Lope-Alzina, D. G., & Ordóñez-Díaz M.J. (2018). Los huertos familiares en la Península de Yucatán. In Atlas biocultural de huertos familiares en México: Chiapas, Hidalgo, Oaxaca, Veracruz y Península de Yucatán. Ordóñez-Díaz M. J. (ed.); UNAM, CRIM, México, pp: 331-339.
3. Mariaca-Méndez, R. (2013). La complejidad del huerto familiar maya del Sureste de México. In El huerto familiar del Sureste de México. Mariaca-Méndez, R. (ed.); Secretaría de Recursos Naturales y Protección Ambiental del Estado de Tabasco, ECOSUR, México, pp: 7-97.

4. Barranco-Vera, S.G., Montañez-Escalante, P.I., Ruene-Morales, M.R., & Jiménez-Osornio, J.J. (2023). Aprovechamiento de la fauna en huertos familiares y selva en dos comunidades de Yucatán, México. *Tropical and Subtropical Agroecosystems*. 26(3): 1-14. doi: 10.56369/tsaes.4736
5. Sánchez-Soto, S. (2018). Vertebrados silvestres observados en un huerto familiar de la Chontalpa, Tabasco, México. *Revista Nicaragüense de Biodiversidad*. 29: 1-42.
6. Sánchez-Soto, S. (2016). Informe de frutos dañados por *Amazona albifrons* Sparman, en Tabasco, México. *Agronomía Mesoamericana*. 27(2): 415-419. doi: doi.org/10.15517/am.v27i2.21282
7. Orellana-Lanza, R., Espadas-Manrique, C., & Nava-Marín, F. (2010) Climas. In Biodiversidad y Desarrollo Humano en Yucatán. Duran-García R., & Méndez-González M.E. (eds.); CICY, PPD-FMAM, CONABIO, SEDUMA, México, pp: 10-11.
8. Bautista-Zúñiga, F., Frausto-Martínez, O., IhI, T., & Aguilar-Duarte, Y. (2010) El relieve. In Biodiversidad y Desarrollo Humano en Yucatán. Duran-García R., & Méndez-González M.E. (eds.); CICY, PPD-FMAM, CONABIO, SEDUMA, México, pp: 7-9.
9. García-Gil, G., Méndez-González, L., Aguilar-Cordero W.J., & Orellana-Lanza, R. (2010) Ambientes terrestres. In Biodiversidad y Desarrollo Humano en Yucatán. Duran-García R., & Méndez-González M.E. (eds.); CICY, PPD-FMAM, CONABIO, SEDUMA, México, pp: 17-20.
10. Flores-Guido, J.S., Durán-García, R., & Ortíz-Díaz, J.J. (2010) Comunidades vegetales terrestres. In Biodiversidad y Desarrollo Humano en Yucatán. Duran-García R., & Méndez-González M.E. (eds.); CICY, PPD-FMAM, CONABIO, SEDUMA, México, pp: 125-129.
11. Bibby, C.J., Burgess, N.D., Hill, D.A., & Mustoe, S.H. (2002). Bird census techniques. London: Academic Press. 302 pp.
12. Howell, S.N.G., & Webb, S. (1995). A guide to the birds of Mexico and Northern Central America. Oxford University Press, Oxford, RU. 839 pp.
13. Peterson, R.T. & Chalif, E.L. (1989). Aves de México. Guía de campo. México, D. F. Editorial Diana. 473 pp.
14. Van Perlo, P. (2006). Birds of Mexico and Central America (Princeton Illustrated Checklist). New Jersey: Princeton, University Press. 336 pp.
15. Berlanga, H., Gómez-de Silva, H., Vargas-Canales, V.M., Rodríguez-Contreras, V., Sánchez-González, L.A., Ortega-Álvarez, R., & Calderón-Parra, R. (2019). Aves de México: Lista actualizada de especies y nombres comunes. México: CONABIO.
16. SEMARNAT (Secretaría de Medio Ambiente y Recursos Naturales) (2010). Norma Oficial Mexicana y fauna silvestres. Categorías de riesgo y especificaciones para su inclusión, exclusión o cambio. Lista de especies en riesgo. Diario Oficial, 30 de diciembre de 2010, 2ª Sección. México, DF.
17. Chablé-Santos J.; Pasos-Enríquez, R. (2010). Aves. In Biodiversidad y Desarrollo Humano en Yucatán. Duran-García R., & Méndez-González M.E. (eds.); CICY, PPD-FMAM, CONABIO, SEDUMA, México, pp: 264-266.
18. Montañez-Escalante, P.I., Ruenes-Morales, M.R., Jiménez-Osornio, J.J., Chimal-Chan, P., & López-Burgos, L. (2012). Los huertos familiares o solares en Yucatán. In El huerto familiar del Sureste de México. Mariaca-Méndez, R. (ed.). Secretaría de Recursos Naturales y Protección Ambiental del Estado de Tabasco, ECOSUR, México, pp: 131-148.
19. Heredia-Campos, E.B. (2020). Uso, manejo, percepción de la fauna, desde la cosmovisión maya en los huertos familiares de Yaxcabá y Yuxunah, Yucatán. Tesis de Maestría, El Colegio de la Frontera Sur, Campeche, México, 17 de julio del 2020.
20. Arriaga-Weiss, S.L. (2008). Avifauna en un paisaje antropizado en el Parque Estatal de la Tierra. Tesis de Doctorado, El Colegio de la Frontera Sur, Quintana Roo, México, julio del 2008.
21. Turner, I.M. (1996). Species loss in fragments of tropical rain forest: a review of the evidencia. *Journal Applied Ecology* 33(3): 200 – 209. doi: 10.2307/2404743
22. Barrett, G.W., Ford, H.A., & Recher. H.F. 1994. Conservation of woodland birds in a fragmented rural landscape. *Pacific Conservation Biology* 1: 245-256. doi: 10.1071/PC940245
23. Van der Wal, H., Viveros-Salinas J.L., Pérez-Ramírez, I., Vargas-Domínguez, M., & Poot-Pool, W.S. (2019). Diversidad en huertos familiares. In La Biodiversidad en Tabasco. Estudio de Estado. Mata-Zayas E.E., & Palma-López, D.J. (eds.), CONABIO, México, pp: 185-192.
24. Basset, Y., Aberlenc, H.P., Delvare, G. (1992). Abundance and stratification of foliage arthropods in a lowland rain forest of Cameroon. *Ecological Entomology*. 17: 310-318. doi: <https://doi.org/10.1111/j.1365-2311.1992.tb01063.x>
25. Rangaiah, K., Purnachandra-Rao, S.; & Solomon-Raju J. (2004). Bird-pollination and fruiting phenology in *Spathodea campanulata* Beauv. (Bignoniaceae). *Beitr. Biol. Pflanzen* 73: 395-408.

26. Saleem, H., Usman, A., Fawzi-Mahomoodally, M., & Ahemad, N. (2021). *Bougainvillea glabra* (choisy): A comprehensive review on botany, traditional uses, phytochemistry, pharmacology and toxicity. *Journal of Ethnopharmacology* 266: 113356 doi: 10.1016/j.jep.2020.113356
27. Arriaga-Weiss, S.L. (1985). Evaluación preliminar del daño causado por aves en cacaotales de la Chontalpa, Tabasco. *Divulgación Científica* 4: 155-161.
28. López-Muñoz, E.C., Enríquez, P.L., Saldaña-Vázquez, R.A., Hernández-Morales, F., & Vandame, R. (2022) Diversidad avifaunística y gremios tróficos en tres condiciones diferentes de cobertura vegetal selvática, al sureste de Chiapas, México. *Acta Zoológica Mexicana*. 38: 1.36. doi: doi.org/10.21829/azm.2022.3812434

