

# Autumn-Winter Bird Richness and Diversity in Mango (*Mangifera indica* L.) Crops in Escuinapa, Sinaloa, and Their Contribution to Sustainable Development Goal fifteen

Gurrola-López, Guadalupe H.<sup>1,2</sup>; Álvarez-Mares, Vicente<sup>2</sup>; González-Bernal, Marco A.<sup>1</sup>; Rojas-Aguilar, Edmi I.<sup>3</sup>; Medina-Montenegro, Heidi M.<sup>2\*</sup>

<sup>1</sup> Universidad Autónoma de Sinaloa, Facultad de Biología, Avenida de las Américas y Universitarios, s/n, Ciudad Universitaria, Culiacán, Sinaloa, México. C. P. 80013.

<sup>2</sup> Universidad Tecnológica de Culiacán Carretera Culiacán Imala Km 2, Colonia Los Ángeles, Culiacán, Sinaloa, México, C. P. 800XX.

<sup>3</sup> Universidad Autónoma de Occidente, Gabriel Leyva 300 Norte, Los Mochis, Sinaloa, México. C. P. 81200.

\* Correspondence: medina.heidi@utculiacan.edu.mx

## ABSTRACT

**Objective:** To assess the richness and diversity of bird species inhabiting mango orchards and to examine their contribution to Sustainable Development Goal (SDG) 15 of the 2030 Agenda, which is focused on biodiversity conservation.

**Design/methodology/approach:** Linear transects of 3,000 m were surveyed with five repetitions, each separated by 500 m. Intensive sampling was conducted, and all birds seen and heard were recorded. Species identification was performed using field guides and 8×40 binoculars. Species richness was determined based on the cumulative number of species recorded during sampling; abundance was estimated by summing the number of individuals observed for each species; and bird diversity was calculated using the Shannon-Wiener index.

**Results:** A total of 1,320 individual birds belonging to 60 species were recorded. This assemblage was distributed across 11 orders, 27 families, and 48 genera. Twelve species were found to be under legal protection according to the national criteria established in NOM-059-SEMARNAT-2010, as well as the international criteria of the International Union for Conservation of Nature (IUCN) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Six species were endemic to Mexico, and 17 were identified as being of conservation concern.

**Limitations on study/implications:** The available findings are partial, as they include only the autumn and winter seasons with respect to species richness and diversity.

**Findings/conclusions:** The environmental system associated with mango cultivation contributes to the conservation of bird diversity and, consequently, to the fulfillment of SDG 15 of the 2030 Agenda.

**Keywords:** Ornithology, Agroecology, Fruit Growing, Sustainability.

**Citation:** Gurrola-López, G. H., Álvarez-Mares, V., González-Bernal, M. A., Rojas-Aguilar, E. I., & Medina-Montenegro, H. M. (2026). Autumn-Winter Bird Richness and Diversity in Mango (*Mangifera indica* L.) Crops in Escuinapa, Sinaloa, and Their Contribution to Sustainable Development Goal fifteen. *Agro Productividad*. <https://doi.org/10.32854/sdzwz578>

**Academic Editor:** Jorge Cadena Iñiguez

**Associate Editor:** Dra. Lucero del Mar Ruiz Posadas

**Guest Editor:** Juan Francisco Aguirre Medina

**Received:** December 8, 2025.

**Accepted:** March 12, 2026.

**Published on-line:** May 25, 2026.

*Agro Productividad*, 19(3). March. 2026. pp: 123-134.

This work is licensed under a Creative Commons Attribution-Non-Commercial 4.0 International license.



## INTRODUCTION

The conversion of natural habitats into land for human activities, such as urbanization and the development of agricultural and fruit crops, entails the removal of vegetation cover and, consequently, exerts direct impacts on the distribution and abundance of biodiversity



(Lewiston-Maine, 2011). This transformation alters the quality of the environmental services that ecosystems provide to humanity, including atmospheric gas regulation, soil formation, climate regulation and stability, nutrient cycling, pollination, biological control, pollutant decomposition, and recreation (Bolund and Hunhammar, 1999; Pérez-García, 2020). In this regard, habitat removal, degradation, and fragmentation caused by human activities are considered among the principal drivers of biodiversity loss and species extinction (Tinajero and Rodríguez, 2012; Reyes-Palomino and Cano-Ccoa, 2022). This situation, on the one hand, underscores the urgent need to evaluate the adverse effects of environmental change trends on wild populations; on the other hand, it also highlights the importance of assessing the beneficial contributions of perennial crops to soil conservation, carbon sequestration, and the provision of refuge for wildlife, particularly birds (Lozano-Nieto, 2022). In Mexico, mango is one of the 303 agri-food products cultivated across 23 states. In Sinaloa, according to data from the Agrifood and Fisheries Information System, mango cultivation expanded by 37.3% in 2023, reaching 49,133 cultivated hectares (CODESIN, 2024). These orchards are located primarily in the municipalities of Mazatlán, Concordia, Rosario, and Escuinapa (Balderas-Palacios *et al.*, 2017), positioning Sinaloa as the second-leading mango-producing state nationwide. At present, mango cultivation in Sinaloa is of considerable socioeconomic relevance. Together with postharvest management, it is driving the southern region of the state toward becoming a hub of industrial growth and foreign exchange generation (Montaño-López, 2024), largely through the creation of temporary and permanent employment opportunities that enhance the quality of life of local inhabitants (Izabal de la Garza and Torres-Jaquez, 2024). Nevertheless, the crop faces serious problems associated with the externalization of production costs as a consequence of prolonged drought periods and extreme meteorological events, resulting in reduced harvest volumes and diminished product quality. Given this context, which has evolved into a multifaceted problem involving social, environmental, and economic dimensions, mango production systems must begin to develop within sustainable agroecosystems characterized by optimal biological processes, while their agricultural activities should be aligned with the goals of the Sustainable Development Goals (SDGs), particularly Goal 15, “Life on Land,” established by the United Nations (UN) under the 2030 Agenda. This goal calls for urgent and meaningful action to reduce the degradation of natural habitats and halt biodiversity loss in the geographical areas where such activities take place (United Nations, 2018; Manríquez-García and Vences-Macedo, 2022). Based on the foregoing, bird richness and diversity associated with habitats transformed for mango cultivation were determined during the autumn and winter seasons in order to contribute to the understanding of the interactions between this taxonomic group and mango cultivation, as well as to analyze its contribution to the targets of SDG 15 (United Nations, 2018).

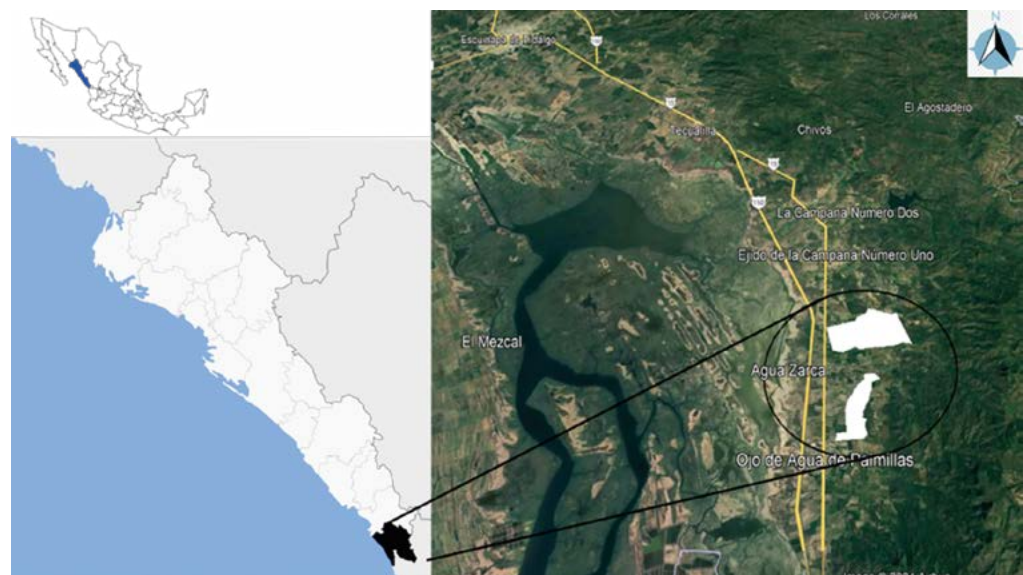
## **MATERIALS AND METHODS**

The study area corresponded to the municipality of Escuinapa, located in the southern part of the state of Sinaloa. Sampling was conducted between the communities of Ejido La Campana Número Uno and Ojo de Agua de Palmillas, between the geographic coordinates 22° 41' 45" N, 105° 35' 58" W and 22° 37' 34" N, 105° 36' 31" W. The climate of the

region is warm subhumid with summer rainfall, with a mean annual temperature of 32.5 °C and an average annual precipitation of 68.9 mm (INEGI, 2010). Sampling surveys were carried out in mature, productive orchards of the Aaulfo, Kent, Keith, Veracruzano, Jade, Tommy, and Manila varieties (Figure 1).

To determine bird richness and diversity in mango orchards, 3,000 m linear transects were established for intensive sampling (five repetitions), with a separation of 500 m between each transect, each representing an independent sampling unit within a defined area (Ralph *et al.*, 1996). Surveys were conducted from September to December 2024 in a motor vehicle at an average speed of 20 km h<sup>-1</sup>, which made it possible to identify and count all birds seen and heard (Tinajero and Rodríguez-Estrella, 2012). Surveys began within the first 15 minutes after sunrise and continued for the following four hours, whereas afternoon monitoring commenced three hours before sunset (Molina *et al.*, 2012). Species identification was carried out using field guides for the birds of Mexico and North America (Howell and Webb, 1995; Sibley, 2004; Kaufman, 2005; Dunn and Alderfer, 2008) and 8×40 binoculars.

Species richness was determined by summing the cumulative number of species recorded throughout the surveys (Bojorges-Baños, 2006). Species records followed the taxonomy adopted by the American Ornithologists' Union (1988), in accordance with the North American bird checklist (Chesser *et al.*, 2024a), which incorporates the changes included in Supplement 65 (Chesser *et al.*, 2024b). Protection status was assigned according to the national criteria established in NOM-059-SEMARNAT-2010 (SEMARNAT, 2019), as well as the international criteria of the Red List of the International Union for Conservation of Nature (IUCN, 2012) and the appendices of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, 2013). Species of conservation interest were determined according to their protection status and endemism (BirdLife International, 2006).



**Figure 1.** Location of the sampling area in the municipality of Escuinapa, Sinaloa, Mexico.

The abundance of each species present in the mango cultivars was recorded in order to calculate the Shannon-Wiener index ( $H'$ ), described as follows: diversity ( $H'$ ) is equal to the negative summation of the relative abundance of each recorded species ( $P_i$ ) multiplied by its natural logarithm ( $\ln P_i$ ) (Moreno, 2001; Gurrola, 2018), according to the following formula:

$$H' = -\sum P_i \times \ln P_i$$

where:  $P_i$ =the relative abundance of species  $i$ , obtained from  $n_i$ , which is equal to the number of individuals of species  $i$  divided by  $\sum n$ , where  $\sum n$  is the total number of individuals (Bojorges-Baños, 2006; Ramírez-Albores, 2010).

## RESULTS AND DISCUSSION

A total of 1,320 birds belonging to 60 species were recorded during the autumn-winter season of 2024 in association with mango orchards. These were grouped into 11 orders, 27 families, and 48 genera (Table 1). The order Passeriformes was the best represented, with 15 families and 37 species, accounting for 61.7% of the species comprising the total species richness. The families with the greatest number of species were Columbidae and Tyrannidae, with seven species each, followed by Parulidae with six, Icteridae with five, Cardinalidae and Trochilidae with four each, and Corvidae with three. Particularly noteworthy was the presence of the Eurasian Collared-Dove (*Streptopelia decaocto* F.) and the House Sparrow (*Passer domesticus* L.), both considered invasive exotic species primarily associated with urban and agricultural areas (De Laet and Summers-Smith, 2007; Alvarez-Alvarez, 2022). These species have expanded their distribution into mango cultivation systems, where they compete with native species for food resources and nesting sites and act as vectors of disease transmission, thereby exerting negative effects through the decline of wild bird populations (González-Zamora *et al.*, 2016; Blanco *et al.*, 2024). Furthermore, their presence in other agroecosystems of Sinaloa is considered a problem that may ultimately influence the agricultural productivity of the system (Gurrola *et al.*, 2016).

September exhibited a richness of 53 species, of which the Sinaloa Crow (*Corvus sinaloae* D.), Red-billed Pigeon (*Patagioenas flavirostris* W.), and Blue Grosbeak (*Passerina caerulea* L.) were the most abundant, with 65, 26, and 25 individuals recorded, respectively. October was the month with the lowest species richness, with 43 species recorded. The most abundant species were the Common Ground-Dove (*Columbina passerina* L.) with 27 individuals, followed by the Lark Sparrow (*Chondestes grammacus* S.) with 24, and the Sinaloa Crow with 17.

In November, a richness of 56 species was recorded. Among these, the most abundant were the Sinaloa Crow with 80 individuals, the Lark Sparrow with 42, the White-winged Dove (*Zenaida asiatica* L.) with 33, the Purplish-backed Jay (*Cyanocorax beecheii* V.) with 30, and the Common Ground-Dove with 25.

Finally, December was the month with the highest species richness, with 59 species recorded. The most abundant species during this month were the Sinaloa Crow (*Corvus*

**Table 1.** List of species observed in mango orchards located in the municipality of Escuinapa, Sinaloa, Mexico. Species of conservation interest\*, according to NOM-059-SEMARNAT-2010 (SP=Special Protection; T=Threatened; E=Endangered), Endemism status, the International Union for Conservation of Nature (IUCN) (NT=Near Threatened), and Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

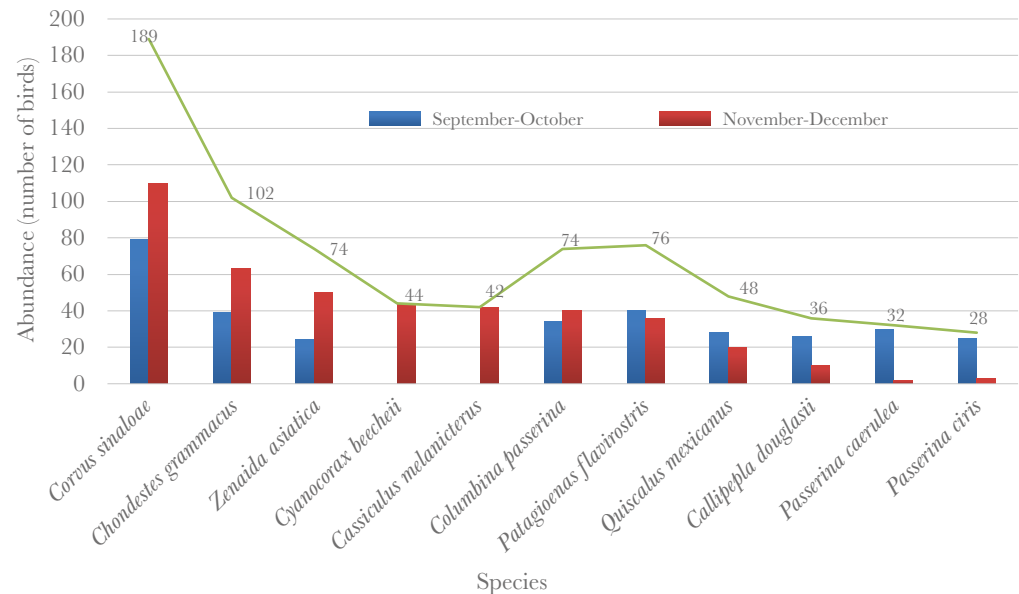
Number	Order	Family	Scientific Name	Status	NOM 059	UICN, CITES
1	Galliformes	Cracidae	<i>Ortalis wagleri</i> *	Endemic		
2		Odontophoridae	<i>Callipepla douglasii</i> *	Endemic		
3	Columbiformes	Columbidae	<i>Columbina inca</i>	Native		
4			<i>Columbina passerina</i>	Native		
5			<i>Columbina talpacoti</i>	Native		
6			<i>Zenaida asiatica</i>	Native		
7			<i>Zenaida macroura</i>	Native		
8			<i>Patagioenas flavirostris</i>	Native		
9			<i>Streptopelia decaocto</i>	Exotic		
10	Cuculiformes	Cuculidae	<i>Crotophaga sulcirostris</i>	Native		
11	Apodiformes	Trochilidae	<i>Archilochus alexandri</i> *	Native		II
12			<i>Calypte costae</i> *	Native		II
13			<i>Cynanthus latirostris</i> *	Native		II
14			<i>Amazilia rutila</i> *	Native		II
15	Pelecaniformes	Ardeidae	<i>Ardea ibis</i>	Exotic		
16	Cathartiformes	Cathartidae	<i>Cathartes aura</i>	Native		
17	Accipitriformes	Accipitridae	<i>Parabuteo unicinctus</i> *	Native	SP	II
18		Accipitridae	<i>Buteo plagiatus</i> *	Native		II
19	Strigiformes	Strigidae	<i>Glaucidium brasilianum</i> *	Native		II
20	Piciformes	Picidae	<i>Melanerpes uropygialis</i>	Native		
21			<i>Dryobates scalaris</i>	Native		
22	Falconiformes	Falconidae	<i>Caracara plancus</i>	Native		
23			<i>Falco sparverius</i> *	Native		II
24	Passeriformes	Tyrannidae	<i>Myiarchus cinerascens</i>	Native		
25			<i>Pitangus sulphuratus</i>	Native		
26			<i>Myiozetetes similis</i>	Native		
27			<i>Tyrannus melancholicus</i>	Native		
28			<i>Tyrannus vociferans</i>	Native		
29			<i>Tyrannus forficatus</i>	Native		
30			<i>Pyrocephalus rubinus</i>	Native		
31	Passeriformes	Vireonidae	<i>Vireo gilvus</i>	Native		
32		Laniidae	<i>Lanius ludovicianus</i> *	Native		CA
33		Corvidae	<i>Cyanocorax beecheii</i> *	Endemic	E	
34			<i>Corvus sinaloae</i> *	Endemic		
35			<i>Corvus corax</i>	Native		
36		Hirundinidae	<i>Stelgidopteryx serripennis</i>	Native		
37		Poliophtilidae	<i>Poliophtila caerulea</i>	Native		
38			<i>Poliophtila nigriceps</i>	Endemic		

**Table 1.** Continues...

Number	Order	Family	Scientific Name	Status	NOM 059	UICN, CITES	
39	Passeriformes	Mimidae	<i>Mimus polyglottos</i>	Native			
40		Turdidae	<i>Turdus rufopalliatus</i> *	Endemic			
41		Passeridae	<i>Passer domesticus</i>	Exotic			
42		Fringillidae	<i>Haemorhous mexicanus</i>	Native			
43		Passerellidae	<i>Chondestes grammacus</i>	Native			
44		Icteridae		<i>Cassiculus melanicterus</i>	Native		
45				<i>Icterus spurius</i>	Native		
46				<i>Icterus pustulatus</i>	Native		
47				<i>Molothrus aeneus</i>	Native		
48				<i>Quiscalus mexicanus</i>	Native		
49		Parulidae		<i>Leiothlypis celata</i>	Native		
50				<i>Leiothlypis lucidae</i>	Native		
51				<i>Geothlypis tolmiei</i> *	Native	T	
52				<i>Setophaga petechia</i>	Native		
53				<i>Setophaga nigrescens</i>	Native		
54				<i>Cardellina pusilla</i>	Native		
55		Cardinalidae		<i>Piranga rubra</i>	Native		
56				<i>Piranga ludoviciana</i>	Native		
57				<i>Passerina caerulea</i>	Native		
58				<i>Passerina ciris</i> *	Nativa	SP	
59	Thraupidae		<i>Volatinia jacarina</i>	Nativa			
60			<i>Sporophila torqueola</i> *	Endemic			

*sinaloae*) with 30 individuals, the Mexican Cacique (*Cassiculus melanicterus* B.) with 22, the Lark Sparrow with 21, the White-winged Dove with 17, and the Red-billed Pigeon with 17 (Figure 2). The bird richness documented in this study exceeds the 51 species reported by García-Núñez *et al.* (2020) in an agroforestry system with coffee cultivation located at an altitude of 1,933 m above sea level in the municipality of Huatusco, Veracruz, Mexico. It is important to note that the present study encompasses only four months of the autumn and winter seasons; therefore, bird richness is expected to increase substantially as the sampling period is extended. In this context, the species richness recorded in the mango cultivars of the municipality of Escuinapa is considered to be well represented for the study period (autumn-winter), which may be explained by the migratory phenomenon occurring during this time of year (Van der Heiden *et al.*, 2018).

As this represents an initial effort to document bird diversity in this type of modified environment, it is essential to continue sampling during the remaining two seasons of the year, given that the 60 species recorded account for 14.1% of the ornithological richness reported for Sinaloa by Navarro-Sigüenza *et al.* (2014). This positions mango orchards as an agroecological system of particular interest for faunistic studies aimed at generating



**Figure 2.** Most abundant species in mango cultivars of the Aaulfo, Kent, Keith, Veracruzano, Jade, Tommy, and Manila varieties (author's own elaboration).

knowledge on their contribution to biodiversity conservation and to the Sustainable Development Goals of the 2030 Agenda.

During the bird surveys, photographs of several species using the habitat created by mango cultivation were obtained (Figure 3), thereby providing evidence that this system offers resources available to the bird community adapted to this ecosystem (Sánchez-Núñez and Monge-Meza, 2022). These same authors indicate that mango was the crop most visited by birds, with 29 of the 55 species recorded at the Fabio Baudrit Moreno Agricultural Experimental Station, located in La Garita de Alajuela, Costa Rica. Although the studies were conducted in geographically distant locations, there is agreement in the occurrence of 15 species: the Inca Dove (*Columbina inca* L.), Ruddy Ground-Dove (*Columbina talpacoti* T.), White-winged Dove, Red-billed Pigeon, Groove-billed Ani (*Crotophaga sulcirostris* S.), Gray Hawk (*Buteo plagiatus* S.), Crested Caracara (*Caracara plancus* M.), Great Kiskadee (*Pitangus sulphuratus* L.), Tropical Kingbird (*Tyrannus melancholicus* V.), Great-tailed Grackle (*Quiscalus mexicanus* G.), Yellow Warbler (*Setophaga petechia* L.), Wilson's Warbler (*Cardellina pusilla* W.), Summer Tanager (*Piranga rubra* L.), Painted Bunting (*Passerina ciris* L.), and Blue-black Grassquit (*Volatinia jacarina* L.).

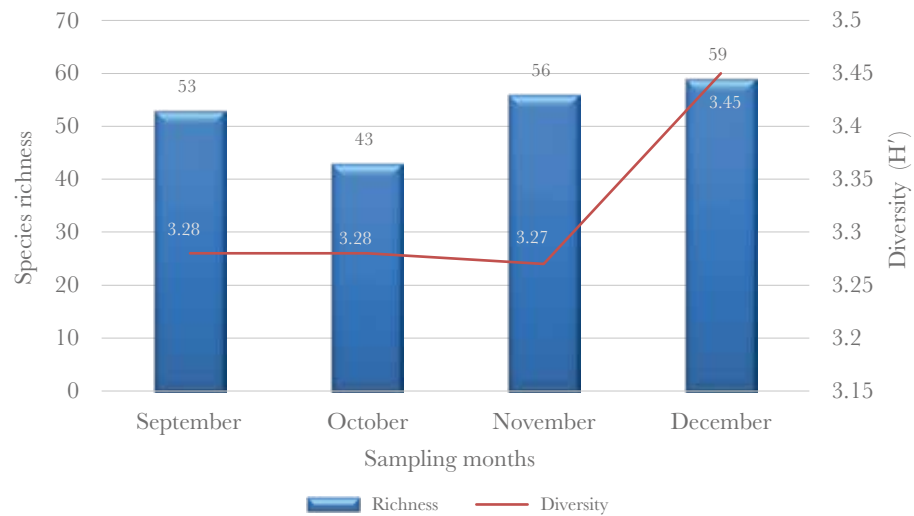
A total of 12 species (20%) of the 60 recorded were found to be under legal protection status according to national and international criteria. Of these, four fall under one of the categories established in NOM-059-SEMARNAT-2010 (two under Special Protection, one as Threatened, and one as Endangered), one species is included on the IUCN Red List in the Near Threatened (NT) category, and eight are listed in Appendix II of CITES. Of the recorded species, six are classified as endemic to Mexico. Data analysis revealed 17 species of conservation interest. The Purplish-backed Jay and Tolmie's Warbler (*Geothlypis tolmiei* T.) were identified as the most threatened species at the national level, whereas at



**Figure 3.** Representative species during the autumn-winter season. 1. Groove-billed Ani, 2. Painted Bunting, 3. Purplish-backed Jay, 4. Great Kiskadee, 5. Great-tailed Grackle, 6. Costa's Hummingbird (*Calypte costae* B.), 7. Cattle Egret (*Ardea ibis* L.), 8. Black-throated Gray Warbler (*Setophaga nigrescens* T.), 9. Yellow Warbler (author's own elaboration).

the international level the most threatened were the Loggerhead Shrike (*Lanius ludovicianus* L.), followed by the Harris's Hawk (*Parabuteo unicinctus* T.). These results are consistent with those of Gurrola *et al.* (2016), who identified the Harris's Hawk (*Parabuteo unicinctus* T.) as a species of conservation interest and as threatened at both the national and international levels. Furthermore, we concur with Medina-Macías *et al.* (2010), who emphasize the urgent need to implement a management program for these vulnerable species.

Based on the presence of the 17 species of conservation interest, the species richness recorded, and the results of the Shannon-Wiener diversity index (Figure 4), we consider the “mango cultivation” environmental system to be of high value for bird conservation, since these indicators are commonly used for this purpose (Gurrola, 2018; Orozco *et al.*, 2024). Our contribution may be regarded as an indicator that agroecosystems constituted by perennial mango crops support the global vision of the Sustainable Development Goals (SDGs) (Gómez-Gil, 2017), particularly in terms of preventing environmental degradation and promoting conservation. Despite the lack of precise responsibilities that has affected the SDGs since their adoption in 2015, this type of evidence reveals the natural self-regulation of ecosystems and their persistent tendency to achieve a balance between the physical and biotic components of the environment.



**Figure 4.** Richness and diversity of bird species in the sampled mango orchards (author's own elaboration).

Shannon-Wiener Diversity Index ( $H'$ ) values of 3.28 were obtained for September and October, while values of 3.27 and 3.45 were recorded for November and December, respectively. Given the limited variability among these values, the results indicate that the resources provided by the “mango cultivation” environmental system support a relatively even and acceptable distribution in the abundance of the 60 recorded bird species, and that this system possesses the natural resources necessary to sustain these bird populations. These findings underscore the importance of modified environments for avifauna, particularly for species of conservation interest (Castro-Caro *et al.*, 2013; Gurrola *et al.*, 2016). The results may suggest that this environmental system is undergoing a process of recovery following the initial land-use transformation from native vegetation cover to mango cultivation, which now functions as an agroecosystem supporting the populations of the 60 species that comprise its bird community, with variability in terms of the spatiotemporal replicability of its ecosystem components and agro-cultural processes (León, 2012). Undoubtedly, this relationship contributes to the targets of SDG 15, particularly with respect to halting biodiversity loss and protecting threatened species in order to prevent their extinction (United Nations, 2018; Lozano-Nieto, 2022). The 17 species of conservation interest considered in this study were identified according to the methodology proposed by BirdLife International (2006). Of these, only the Purplish-backed Jay coincides with the list of priority species and populations for conservation in Mexico (SEMARNAT, 2014). This list also includes the White-winged Dove and the Mourning Dove (*Zenaida macroura* L.), which we did not classify as priority species. These differences may be explained by the distinct criteria used to assign species to this category. Nevertheless, we consider these lists to be complementary tools.

## CONCLUSIONS

The presence of nationally and internationally threatened, as well as endemic, species within mango orchards indicates that these habitats are used for essential daily activities

such as refuge, feeding, and reproduction, thereby underscoring the ecological importance of this environmental system for their persistence. Based on the results, and considering the temporal and spatial limitations of the data, the analysis points to an agroecosystem characterized by variability in its agroecological processes. Taken together, these findings support the conclusion that the “mango cultivation” environmental system contributes to the protection of bird diversity and, consequently, to the targets of SDG 15. Expanding the sample size and continuing surveys during the remaining seasons of the year are recommended in order to conduct a more robust analysis.

## ACKNOWLEDGMENTS

The authors wish to express their gratitude to the Faculty of Biology of the Autonomous University of Sinaloa and to the Coordination of the Sustainable and Protected Agriculture Engineering Program at the Technological University of Culiacán for their respective support of this research.

## REFERENCES

- Alvarez-Alvarez, E. A. (2022). Gorriones domésticos (*Passer domesticus*) usurpan nidos de golondrinas risqueras (*Petrochelidon pyrrhonota*) en el estado de Guerrero, México. *Huitzil Revista Mexicana de Ornitología* 23(2):e641. DOI: <https://doi.org/10.28947/hrmo.2022.23.2.676>.
- American Ornithologists' Union (1998). Check-list of North American Birds. Séptima Edición, Washington, D.C. 829 p.
- Balderas-Palacios, G. F., Urías-López, M. A., González-Carrillo, J. A., González-Acuña, I. J., & Álvarez-Bravo, A. (2017). Distribución temporal y espacial de la escama blanca del mango en Sinaloa, México. *Revista Mexicana de Ciencias Agrícolas*.19:4023-4034.
- BirdLife International (2006). Conservando las Aves Migratorias Neotropicales en los Andes Tropicales. Quito, Ecuador: BirdLife International y U.S. Fish and Wildlife Service. Proyecto financiado por el Acta para la Conservación de Aves Migratorias Neotropicales.
- Blanco, G., Chamorro, D., Lovas- Kiss, A., & Bravo, C. (2024) Seed dispersal by the cosmopolitan house sparrow widens the spectrum of unexpected endozoochory by granivore birds. *Ecology and Evolution*. 14:e11556. <https://doi.org/10.1002/ece3.11556>
- Bojorges-Baños, J.C. (2006). Riqueza de especies de aves: propuestas metodológicas para su evaluación y estimación. *Ciencia y Mar*. (30): 59-64.
- Bolund, P. y Hunhammar, S. (1999). Ecosystem Services in Urban Areas. *Ecological Economics*, 29. 293-301.
- Castro-Caro, J. C., Barrio, I. C., & Tortosa, F. S. (2013) s the effect of farming practices on songbird communities landscape dependent? A case study of olive groves in southern Spain. *Ornithology*. DOI 10.1007/s10336-013-1010-z.
- Chesser, R.T., Billerman, S.M., Burns, K.J., Cicero, C., Dunn, J.L., Hernández-Baños, B.E., Jiménez, R. A., Johnson, O., Kratter, A. W., Mason, N. A., Rasmussen, P.C., & Remsen Jr., J.V. (2024a). Lista de aves de Norteamérica (en línea). Sociedad Americana de Ornitología. Recuperado de <https://checklist.americanornithology.org/taxa/>.
- Chesser, R. T., Shawn M., Billerman, S.M., Burns, K.J., Cicero, C., Dunn, J. L., Hernández-Baños, B.E., Jiménez, R.A., Johnson, O., Kratter, A.W., Mason, N.A., Rasmussen, P.C., & Remsen Jr., J.V., (2024b). Sixty-fifth Supplement to the American Ornithological Society's Check-list of North American Birds. *Ornithology*. 141: 1-21. [doi.org/ 10.1093/ornithology/ukaf015](https://doi.org/10.1093/ornithology/ukaf015).
- Convenio sobre el Comercio Internacional de Especies Amenazadas de Fauna y Flora Silvestre (CITES) (2013). Apéndices I, II y III. CITES y UNEP. 47p.
- De Laet J., Summers-Smith J. D. (2007) The status of the urban house sparrow *Passer domesticus* in north-western Europe: a review. *J Ornithology*. 148(2):275-278. [doi.10.1007/s10336-007-0154-0](https://doi.org/10.1007/s10336-007-0154-0).
- Dunn, L. J. & Alderfer, J. (2008). Field Guide to the Birds of Western North America. National Geographic. Washington, D.C. 447p.
- García-Núñez R.M., Romero-Díaz, C., Ugalde-Lezama, S., & Tinoco-Rueda J.A (2020) Vegetación y estructura del hábitat que determina la dieta de aves insectívoras en sistemas agroforestales. *Revista Mexicana de Ciencias Agrícolas* 11(4):853-864.

- Gómez Gil, C. (2017) Objetivos del Desarrollo Sostenible (ODS): una revisión crítica. *Papeles de las relaciones ecosociales y cambio global*. 140(18):107-118.
- González-Zamora D.A., Angulo-Castellanos, L.F., Hernández-Vázquez, S., Almanza-Rodríguez, H., & Aguilar-Nuño, L.A. (2016) Presencia de la paloma turca (*Streptopelia decaocto*) en el archipiélago de Revillagigedo, México. *Huitzil Revista Mexicana de Ornitología*. 17(1)151-154.
- Gurrola-López, G.H., Castañeda Lomas, N., Rivera-Rodríguez, L.B., Ruvalcaba, L.P., & Heredia Pineda F.J. (2016). Diversity and Abundance of Birds in Agricultural Zone Associated to the Bay Santa María La Reforma, Sinaloa, Mexico. *Open Access Library Journal*, 3: e3229. doi.org/10.4236/oalib.1103229.
- Gurrola-López, G.H. (2018). Diversidad y estatus de protección de las aves del Estado de Sinaloa, México: caso de estudio Bahía Santa María La Reforma, Sinaloa, México. Tesis de Doctorado. Universidad Autónoma de Sinaloa. México.
- Howell, S.N.G. & Webb, S. (1995) A guide to the Birds of México and Northern Central America, Oxford, Universidad Press. 851p.
- Instituto Nacional de Estadística y Geografía (INEGI) (2010). Compendio de información geográfica municipal 2010. Escuinapa, Sinaloa. Recuperado de: [https://www.inegi.org.mx/contenidos/app/mexicocifras/datos\\_geograficos/25/25009.pdf](https://www.inegi.org.mx/contenidos/app/mexicocifras/datos_geograficos/25/25009.pdf)
- Izabal de la Garza, E.J., & Torres-Jaquez, M. E. (2024) Industria del mango en Sinaloa. Su estudio desde las ciencias sociales y el desarrollo regional. p. 113-126. En Contreras-Loera M.R., Espinoza-Palomeque, B., & Reyes-Guerrero, D., Coordinadores. La gestión del Mango su cultivo, postcosecha e impacto económico y social. Editorial Universidad Tecnológica de Escuinapa. 145p.
- Kaufman, K. (2005). Guía de campo a las aves de Norteamérica. Hillstar Editions L.C. Singapore. 391p.
- León, S.T. (2012). Agroecología: la ciencia de los agroecosistemas-la perspectiva ambiental. Universidad Nacional de Colombia-Instituto de Estudios Ambientales. 261 p.
- Lewiston-Maine S. (2011) The impacts of urbanization on the abundance and distribution of the torogoz (*Eumomota superciliosa apiaster*) and talapo (*Momotus momota lessonii*) in the municipality of San Salvador in the city of San Salvador, El Salvador. Tesis de Licenciatura. Faculty of the Environmental Studies Program. Bates Collage.
- Lozano-Nieto, E.C. (2022) Elementos que caracterizan a los sistemas silvopastoriles, beneficios que aportan al ambiente y a los productores. Examen Complexivo de Licenciatura. Universidad Técnica de Machala. Ecuador.
- Manríquez-García, N. & Vences-Macedo, L. (2022). Producción orgánica de mango en Escuinapa, Sinaloa: una aproximación a la economía solidaria en la región. Boletín Ciudades y Regiones, Nueva Época. Recuperado de [www. https://www.Boletinciudades yregiones.org/2022/05/produccion-organica-de-mango-en.html](https://www.Boletinciudades yregiones.org/2022/05/produccion-organica-de-mango-en.html).
- Medina-Macías, M.N., González-Bernal M.A., & Navarro-Sigüenza, A.G. (2010). Distribución altitudinal de las aves en una zona prioritaria en Sinaloa y Durango, México. *Revista Mexicana de Biodiversidad*. 81:487-503.
- Molina, D., Torres-Guerrero J. & Avelarde-Gómez, M.L. (2012). Riqueza de aves del Área Natural Protegida Estero El Salado, Puerto Vallarta, Jalisco, México. *Huitzil* 13(1): 22-38.
- Montaño-López, G. (2024) Cadena comercial de la agroindustria del mango en el sur de Sinaloa 2023. p. 71-80. En Contreras-Loera M.R., Espinoza-Palomeque, B., & Reyes-Guerrero, D. Coordinadores. La gestión del Mango su cultivo, postcosecha e impacto económico y social. Editorial Universidad Tecnológica de Escuinapa. 145p.
- Moreno, C.E. (2001) Métodos para medir la biodiversidad. M&T-Manuales y Tesis SEA, Vol. 1. Zaragoza, 84 pp.
- Naciones Unidas (2018) La Agenda 2030 y los Objetivos de Desarrollo Sostenible: una oportunidad para América Latina y el Caribe (LC/G.2681-P/Rev.3), Santiago.
- Navarro-Sigüenza, A.G., Rebón-Gallardo, M.F., Gordillo-Martínez, A., Townsend Peterson, A., Berlanga-García, H., & L. A. Sánchez-González (2014) Biodiversidad de aves en México. *Revista Mexicana de Biodiversidad*. 85: 476-495. doi: 10.7550/rmb.41882.
- Orozco-Salazar, A., Macias-Patiño, M., Valdez-Romero, E., Delgadillo-Ruiz, L.; & Mercado-Reyes, M. (2024). Biological importance and environmental quality of the Laguna Santa Ana in Zacatecas, México. *Agro Productividad*. <https://doi.org/10.32854/agrop.v17i10.2605>.
- Pérez-García, J.N. (2020) Causas de la pérdida global de biodiversidad. *Revista de la Asociación Colombiana de Ciencias Biológicas*. 2: 183-198. <https://doi.org/10.47499/revistaaccb.v1i32.219>.
- Ralph, C.J., Geupel, G.R., Pyle, P., Martin, T.E. & DeSante, D.F. (1996). Handbook of field methods for monitoring Landbirds. Gen. Tech. Rep. PSW-GTR-144, Albany, C.A.: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture. 41 p.

- Ramírez- Albores (2010). Diversidad de aves de hábitats naturales y modificados en un paisaje de la depresión central de Chiapas, México. *Rev. Biol. Trop.* 58(1): 511-528.
- Reyes-Palomino, S.E. & Cano-Ccoa, D.M. (2022). Efectos de la agricultura intensiva y el cambio climático sobre la biodiversidad. *Revista de Investigaciones Altoandinas*, 24(1), 53-64. <https://doi.org/10.18271/ria.2022.328>.
- Sánchez-Núñez, C. & Monge-Meza J. (2022) Comunidad de aves y daños que generan en la producción Agrícola en Alajuela, Costa Rica. *Agronomía Costarricense* 46(2):135-146.
- Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) (2014). Acuerdo por el que se da a conocer la lista de especies y poblaciones prioritarias para la conservación. México: Diario Oficial de la Federación.
- Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) (2019). Modificación del anexo III Lista de especies en riesgo de la Norma Oficial Mexicana NOM-059-SEMARNAT-2010, Protección ambiental-Especies nativas de México de flora y fauna silvestres-Categorías de riesgo y especificaciones para su inclusión, exclusión o cambio-Lista de especies en riesgo, publicada el 30 de diciembre de 2010. México: Diario Oficial de la Federación.
- Sibley, D. A. (2004). The Sibley Guide to Birds of Western North America. Alfred A. Knopf Inc. New York. 471 p.
- Tinajero, R., & Rodríguez, E. R. (2012). Efecto de la fragmentación del matorral desértico sobre la aguililla cola roja y el cernícalo americano en Baja California Sur, México. *Acta Zoológica Mexicana* 28(2): 427-446.
- Unión Internacional para la Conservación de la Naturaleza (UICN). (2012). Categorías y Criterios de la Lista Roja de la UICN: Versión 3.1. Segunda edición. Gland, Suiza y Cambridge, Reino Unido: UICN. vi + 34pp. Originalmente publicado como IUCN Red List Categories and Criteria: Version 3.1. Second edition. (Gland, Switzerland and Cambridge, UK: IUCN, 2012).
- Van der Heiden, A. M., Castillo-Guerrero, J.A., Van der Heiden, A.A.K. & Ruiz-Guerrero, M. (2018) Caracterización de la avifauna de La Guásima, Concordia, sur de Sinaloa, México, con énfasis en las especies asociadas a la selva tropical seca y anotaciones sobre especies accidentales y en riesgo. *Revista Mexicana de Biodiversidad* 89:243-267.