

Bicolored Hawk, *Accipiter bicolor* in Guayaquil city (Western Ecuador): new preys-species records and citizen science urban records

Gavilán bicolor, *Accipiter bicolor* en la ciudad de Guayaquil (Occidente de Ecuador): nuevos registros de especies-presa y registros urbanos de ciencia ciudadana

Jaime A. Salas* ^{1,2,3}

<https://orcid.org/0000-0003-3468-5178>
jaime.salasz@ug.edu.ec

Daniel Arias-Cruzatty ⁴

<https://orcid.org/0000-0002-9973-3436>
urbanornis@gmail.com

Miguel Aguilar-Gómez ⁵

<https://orcid.org/0000-0001-9977-0029>
mikespizaetus@gmail.com

Carolina Bravo-Mejía ⁴

<https://orcid.org/0000-0002-5996-6227>
carolina-bravo1989@hotmail.com

Ronny Matamoros ⁶

<https://orcid.org/0000-0003-1183-1611>
roniceronte.ecuador@gmail.com

*Corresponding author

1 Universidad de Guayaquil, Facultad de Ciencias Naturales, Carrera de Biología, Campus Mapasingue, Av Juan Tanca Marengo sin num y Av Raúl Gómez Lince. Guayaquil, Ecuador.

2 Universidad Espíritu Santo, Samborondón, Ecuador.

3 Fundación Desarrollo y Biodiversidad, FUNDEBIO, Guayaquil, Ecuador.

4 UrbanOrnis, Programa de Aves Urbanas, Quito, Ecuador.

5 Nabcí-México, CONABIO, Iniciativa de América del Norte para la conservación de las aves, Comisión Nacional para el uso y conocimiento de la Biodiversidad, Ciudad de México, México.

6 Guía de Turismo. Guayaquil, Ecuador.

Citación

Salas JA, Arias-Cruzatty D, Aguilar-Gómez M, Bravo C, Matamoros R. 2023. Bicolored Hawk, *Accipiter bicolor* in Guayaquil city (Western Ecuador): new preys-species records and citizen science urban records. Revista peruana de biología 30(1): e23857 001- 008 (Marzo 2023). doi: <http://dx.doi.org/10.15381/rpb.v30i1.23857>

Presentado: 31/10/2022

Aceptado: 09/01/2023

Publicado online: 15/03/2023

Editor: Leonardo Romero

Abstract

Accipiter bicolor is a widely distributed Neotropical raptor but knowledge about its ecology is poor, particularly in urban areas. In this work, we document the presence of *A. bicolor* in the city of Guayaquil and in nearby forested areas, in addition, we provide new records on its diet and discuss possible foraging strategies in synanthropic environments. Also, reports of this species are considered on citizen science platforms. *Accipiter bicolor* was observed consuming an individual of *Columbina bluceyi* and another of *Artibeus fraterculus*; near a colony of this species of bat. Finally, we found 59 records of *A. bicolor* between 2007 and 2022 for Guayaquil and its surrounding areas, 14 records were in urban habitats. Observations in different urban and peri-urban habitats are discussed, as well as their feeding habits.

Resumen

Accipiter bicolor es una rapaz Neotropical ampliamente distribuida pero el conocimiento sobre su ecología es escaso en particular en zonas urbanas. En este trabajo, documentamos la presencia de *A. bicolor* en la ciudad de Guayaquil y en áreas boscosas cercanas, además, proveemos nuevos registros sobre su dieta y discutimos posibles estrategias de forrajeo en ambientes sinantrópicas. También, se consideran reportes de esta especie en plataformas de ciencia ciudadana. *Accipiter bicolor* fue observada consumiendo un individuo de *Columbina bluceyi* y otro de *Artibeus fraterculus*; cerca de una colonia de esta especie de murciélago. Finalmente, se encontraron 59 registros de *A. bicolor* entre el 2007 y 2022 para Guayaquil y sus áreas circundantes, 14 registros fueron en hábitat urbanos. Se discute las observaciones en diferentes hábitat urbanos y periurbanos, así como sus hábitos de alimenticios.

Keywords:

Citizen science, eBird, iNaturalist, raptor prey, urban areas.

Palabras clave:

Áreas urbanas, ciencia ciudadana, eBird, iNaturalist, presas.

Introduction

The Bicolored Hawk *Accipiter bicolor* (Vieillot, 1817) is a neotropical resident raptor present in humid and deciduous forests, in lowlands and subtropics, from sea level to 2000 meters of altitude, and his geographical distribution encompasses from central Mexico to southern Chile and Argentina (Bierregaard et al. 2020). The habitat preference of *A. bicolor* is both moist and deciduous forests, even though is rare observe it (Ridgely & Greenfield 2019); it has been observed since the forest understory, approximately 5 m, till to the canopy, above 15 m (Parker & Carr 1992). *Accipiter bicolor* hunt by active aerial pursuit or ambush (Bierregaard et al. 2020; Thorstrom 2012), and has been considered a stealthy and discreet hunter, but also bold or daring (Ridgely & Greenfield 2019).

Journal home page: <http://revistasinvestigacion.unmsm.edu.pe/index.php/rpb/index>

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The diet of *A. bicolor* mainly includes birds (Barrio et al. 2015, Edgardo-Arévalo & Fernández-Otárola 2014, Mader, 1981; Stiles et al. 1989; Thorstrom & Quixchán 2000); also lizards and small mammals, although the identification of these prey is uncertain. In the literature, the mammal prey of *A. bicolor* includes one species of squirrel (*Sciurus* sp.), 3 species of rodents, and 4 species of bats, but the reports don't provide a taxonomic identification at the species level (Robinson 1994, Thorstrom 2012). Another example can be checked in a report about the hunting behavior of *A. bicolor* on bats in the surroundings of the 'Volcán de los Murciélagos' cave in Mexico, but don't provide an identification of these prey either (Mikula et al. 2016). *Accipiter bicolor* is widely distributed in the Neotropics but knowledge about its ecology is scarce (Ridgely & Greenfield 2019).

Recently, various platforms of citizen science approach such as iNaturalist and eBird report observations of wildlife in urban areas, these reports constitute an exceptional opportunity to filling a gap in knowledge on several ecological aspect as the diet, life history, behavior. In this work, we document the presence of *Accipiter bicolor* in urban areas of Guayaquil city and forest remnants near, also provide new records about his diet, and discuss possible foraging strategies in synanthropic environments.

Material and methods

Study area. Guayaquil is the capital city of Guayas province, in Ecuador, and is located at the beginning of the Guayas River. It presents different streams belonging to the inner estuary of the Gulf of Guayaquil, and has a tropical climate, with an average annual rainfall that ranges between 750 and 1000 mm, with an average annual temperature between 24.5 and 26 °C (GAD Municipal Guayaquil 2014). The elevations vary between 50 to 400 meters above sea level and have native forest remnants that correspond to mangroves and tropical dry forests, also known as lowland deciduous forest of the equatorial Pacific (Ministerio del Ambiente del Ecuador 2013).

Field observations. Two birdwatching counts were developing: a survey in January 2018, and a casual observation in February 2021. In the first field observation, DAC and Jorge Luis Vélez Del Hierro carried out a bird count from 6:00 to 9:00 am in an urban area near to streams and mangroves, using Eagle Optics Ranger 8x42 binoculars, and with a Canon PowerShot SX40 HS camera. The hawk was identified as *A. bicolor* for present gray plumage and the rufous color on his thighs, as well as for the tail length and presence of bars on it (Bierregaard et al. 2020, McMullan & Navarrete 2017). The prey was identified following bird field guides (McMullan & Navarrete 2017, Ridgely & Greenfield 2006).

The second observation was opportunistic, where MA, DAC, CB, and RM noticed, observed, and photographed an immature individual of *Accipiter bicolor* while eat a bat in a street in an urban area. The hawk was identified by the diffuse brown hue of its plumage, as well as by the characteristics described above (Bierregaard et

al. 2020, McMullan & Navarrete 2017); the bat was identified by external morphological characteristics from photographs (Tirira 2017, Salas et al. 2018). For validate taxonomic identification of bat and complement information about the possible hunting strategy of the hawk, JAS searched for bat refuges in this urban sector.

Records from citizen science. Finally, we search observations of *Accipiter bicolor* in the city of Guayaquil and its surroundings up to about 15 km, that includes forest remnants and natural reserves, from the Global Biodiversity Information Facility (GBIF 2022), and was validate with a review of records from citizen science biodiversity information platforms (eBird 2021, iNaturalist 2022). With these records, we generate a map of occurrences of the species in the software QGIS 3.16 Hannover (QGIS 2022). All records used were research-grade data quality assessment which means that every observation has a specific date of the event, location, photos, ID supported by two or more birdwatchers.

Results

Prey species registered. The first observation was made on January 13, 2018, at the Malecón Universitario del Estero Salado in Guayaquil (2°8'S, 79°55'W), and an adult individual of *Accipiter bicolor* was observed while ate an Ecuadorian Ground Dove *Columbina bluceyana* (Sclater & Salvin 1877) (Columbiformes: Columbidae), on a tree of saman (*Samanea saman*: Fabaceae). This prey was plucked and dismembered, on the branch of a saman tree, for later consumption. Supplementary material for this observation can be found at the following link (<https://ebird.org/checklist/S41866794>).

In the second observation, another individual of *A. bicolor* was observed on the ground, while ate a bat, with pedestrians and vehicular traffic in the urban center of the city of Guayaquil (2°11.098'S, 79°52.699'W), at the Loja street, near to Escuela Superior Politécnica del Litoral, Campus Las Peñas. This hawk shows an elusive behavior: he moved the prey a few meters ahead, doing small jumps, staying alert, while the pedestrians observed it; this behavior lasted thirty minutes (Fig. 1a). Additional photographic and video materials are available on the eBird portal (<https://ebird.org/checklist/S80558783>), and the link: <https://zenodo.org/record/7530296#Y8BRI3ZBzZY>. The prey was identified as Frateral Fruit-eating Bat *Artibeus fraterculus* Anthony, 1924 (Phyllostomidae: Stenodermatinae), based on the external characteristics observed such as brownish coloration and intensity of the facial lines, which make distinguish from congeners such as *A. lituratus* or *A. aequatorialis*.

Later, on July 12, 2021, between 8:00 and 10:00 am, JAS found a colony of *Artibeus fraterculus* roosting in a disuse old jail (2°11'0.75"S; 79°52'45.74"W; Figure 1b), located approximately 160 meters from the site of the second observation. This structure dates from 1907 and is currently listed as a heritage site (M. I. Municipalidad de Guayaquil 2014). The old prison has a yard with three trees of *Ficus obtusifolia* (Moraceae) (Fig. 1c); inside, on the ground floor, there were 6 cells within small groups

of 3 to 11 individuals of *A. fraterculus*, with a total of approximately 50 individuals (Fig. 1 d, e).

***Accipiter bicolor* records in Guayaquil.** Finally, we obtained 59 records of *Accipiter bicolor* from Guayaquil and surrounding areas (Table 1), between the years 2007 and 2022, which include 5 reserves: Isla Santay Recreation National Area, La Prosperina Protected Forest, Man-

glares El Salado Fauna Production Reserve, Cerro Blanco Protected Forest, and Parque Lago Recreation National Area. The resulting map shows two peri-urban reserves with the most observation records: Cerro Blanco (n=26), La Prosperina (n=10), and three reserves with scarce records as Isla Santay (n=7), Parque Lago (1), El Salado (1); in addition, there were 14 records of this species inside urban areas, in highly altered habitats (Fig. 2).



Figure 1. A) Immature individual of Bicolor Hawk (*Accipiter bicolor*) eating a Fraternal fruit-eating bat (*Artibeus fraterculus*) in the center zone of Guayaquil, Ecuador; B) y C) Doorway and inner yard of the old jail; D) y E) Individuals of *A. fraterculus* inside the cells. Photos by MA (A) and JAS (B, C, D, E).

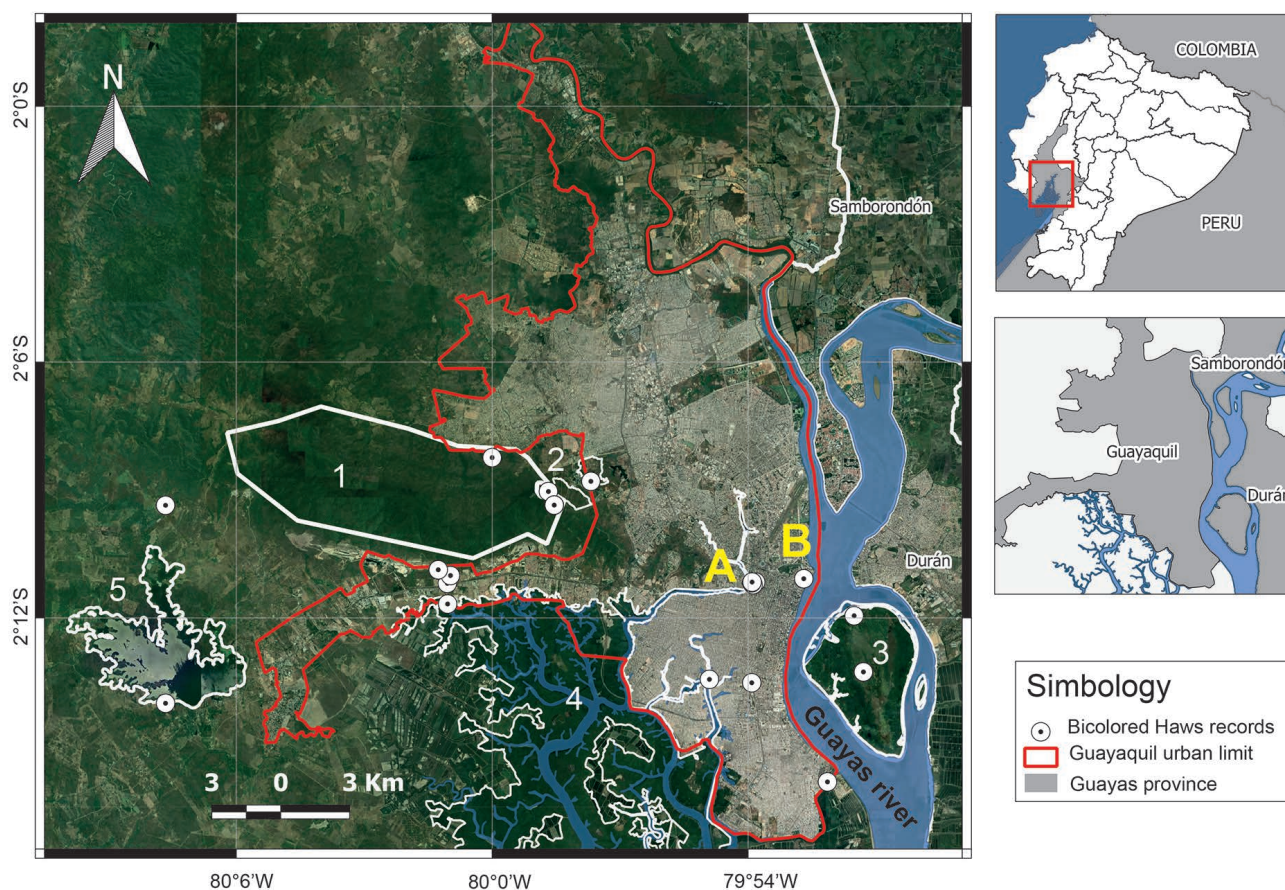


Figure 2. Map of records of Bicolored Hawk *Accipiter bicolor* in Guayaquil and surrounding areas from 2007 to 2022. The records were taken, filtered, and validated from Ebird, iNaturalist, and GBIF. Arabic numbers indicate the reserve's names: 1) Cerro Blanco Protected Forest, 2) La Prosperina Protected Forest, 3) Isla Santay Recreation National Area, 4) Manglares El Salado Fauna Production Reserve, 5) Parque Lago Recreation National Area. Capital letters indicate the localities described in the field phase. A) Malecón Universitario del Estero Salado, B) Loja street, in the center zone of Guayaquil.

Discussion

Herein we report two new prey for *Accipiter bicolor* from Western Ecuador, being remarkable because they came from a densely populated and highly altered coastal urban area, which had not been previously reported (Bierregaard et al. 2020, Ridgely & Greenfield 2019); the presence of *A. bicolor* in urban environments may be due to the availability of shelter and food (Bernat-Ponce et al. 2022). The record of *Columbina buckleyi* as part of *A. bicolor*'s diet is consistent with other prey reported before as doves or similar size birds (Stiles et al. 1989); the *Columbina* doves are abundant and easily observable in the urban area and parks of Guayaquil (Rojas-Allieri & Mang-Ging 2014). Nevertheless, the capture of a bat during the day in urban areas raises some questions, due to the capture strategy used and the availability of food resources.

Accipiter bicolor is a stalker-type opportunistic predator (Bierregaard et al. 2020), it is probable that the juvenile of *A. bicolor* extracted the bat from the old jail, using the trees to perch, and then entered the cells to hunt since it can maneuver in small spaces (Bierregaard et al. 2020). Urban bats can be an easily accessible food resource for predators, such as falcons or accipitrids, which have been reported near these urban roosts (Mikula et al. 2016). The presence of *Artibeus fratercu-*

lus has been reported in Guayaquil previously (Salas et al. 2018), and it is a species that adapts easily to using human structures as shelters (Pinto et al. 2013), so it is a food resource easily accessible by predators. Previously, only the barn owl *Tyto alba* had been reported as a predator of *A. fraterculus* (Moreno 2010, Thomas & Thomas 1977); other authors had suggested that owls such as *Pulsatrix perspicillata*, *Glaucidium peruvianum*, *Megascops roboratus*, *Strix nigrolineata*, *S. virgata*, or the bat-hunter falcon *Falco ruficularis* may be potential predators, based on observations of predation on other species of *Artibeus* (Salas et al. 2018).

Accipiter bicolor has been recorded in various localities around Guayaquil, mostly in forested areas, but there were no records in highly disrupted areas before. The oldest georeferenced records of this species near Guayaquil date from 1991, in Cerro Blanco reserve (Berg 1994, Parker & Carr 1992). Later, Mischler (2012) present an update of birds in this same reserve, and report it as rare, and as breeding in the wet season; currently this reserve has most of the sightings of this species. The second most locality near Guayaquil of *A. bicolor* was in La Prosperina Protected Forest but was not previously registered on this reserve (Pozo-Cajas et al. 2017). Otherwise, the presence of *Accipiter bicolor* in disrupted areas would

Table 1. List of records of Bicolored Hawk *Accipiter bicolor* in Guayaquil and surroundings areas, from 2007 to 2022. The asterisk (*) indicates details of records: * Plaza Rodolfo Baquerizo Moreno, Malecón Universitario, Puente Zig-Zag, Parque Lineal, Puente El Veleró; ** Escuela Politécnica del Litoral (ESPOL), lake and surrounding; the plus sign (+) indicates that there is not information about individual count in the record.

N°	Locality	Individual count	Latitude	Longitude	Event date (d/m/y)	Habitat type	Bird-watcher name	Source
1	Cerro Blanco (Caseta Jaguar)	1	-2.137338	-80.088197	25/8/2022	Forest	Ruben Pineida Escorza	Ebird
2	Isla Santay	1	-2.221130	-79.854900	23/7/2022	Forest	Javier López	Ebird
3	Malecón del Salado and surroundings*	1	-2.186	-79.897	17/4/2022	Urban, Highly intervened	Nancy Hilgert / George Varela	Ebird
4	Malecón del Salado and surroundings*	1	-2.186	-79.897	14/4/2022	Urban, Highly intervened	Nancy Hilgert / George Varela	Ebird
5	Malecón del Salado and surroundings*	1	-2.186	-79.897	8/2/2022	Urban, Highly intervened	George Varela Olivares	Ebird
6	Malecón del Salado and surroundings*	1	-2.185991	-79.898415	26/12/2021	Urban, Highly intervened	Guillaume Normand, Romina Normand	Ebird
7	Cerro Blanco	1	-2.181181	-80.021065	12/12/2021	Forest	Unavailable	GBIF
8	La Prosperina **	1	-2.146625	-79.96141	11/12/2021	Forest	Jorge Abad Lozano, Carla Arias Vélez	Ebird
9	La Prosperina	1	-2.155901	-79.975746	11/12/2021	Forest	Roger Valencia Monroy	Ebird
10	Isla Santay	1	-2.221130	-79.854900	8/12/2021	Forest	Daniel López Condoy	Ebird
11	Cerro Blanco	1	-2.181181	-80.021065	26/11/2021	Forest	Benjamin Navas Hojas	iNaturalist
12	Cerro Blanco	1	-2.181181	-80.021065	4/11/2021	Forest	Unavailable	GBIF
13	Cerro Blanco	1	-2.181181	-80.021065	2/11/2021	Forest	Unavailable	GBIF
14	Cerro Blanco	+	-2.181181	-80.021065	21/10/2021	Forest	Unavailable	GBIF
15	Cerro Blanco	1	-2.181181	-80.021065	29/9/2021	Forest	Benjamin Navas Hojas	GBIF/ iNaturalist
16	Malecón De La Plaza "Cristo Del Consuelo"	1	-2.224033	-79.91508	31/7/2021	Urban, Highly intervened	Wilson Flores	Ebird
17	La Prosperina	1	-2.155901	-79.975746	18/7/2021	Forest	Roger Valencia Monroy	Ebird
18	Poliducto 3 Bocas - Pascuales	1	-2.15598	-79.97246	18/7/2021	Urban, Highly intervened	Roger Valencia Monroy	Ebird
19	La Prosperina **	1	-2.146625	-79.96141	12/6/2021	Forest	George Heimpel	Ebird
20	Cerro Blanco	1	-2.181181	-80.021065	27/5/2021	Forest	Unavailable	GBIF
21	La Prosperina	1	-2.155901	-79.975746	12/5/2021	Forest	Roger Valencia Monroy	Ebird
22	Poliducto 3 Bocas - Pascuales	1	-2.15598	-79.97246	19/4/2021	Urban, Highly intervened	Roger Valencia Monroy	Ebird
23	Cerro Blanco	1	-2.181181	-80.021065	18/4/2021		Unavailable	GBIF
24	Calle Loja, Guayaquil	1	-2.184694	-79.87821	6/2/2021	Urban, Highly intervened	Ronny Matamoros, Olga Bravo, Daniel Arias-Cruzatti, Miguel Aguilar	Ebird
25	Poliducto 3 Bocas - Pascuales	1	-2.15598	-79.97246	19/1/2021	Intervened	Roger Valencia Monroy	Ebird
26	Cerro Blanco	2	-2.181181	-80.021065	19/12/2020	Forest	Unavailable	GBIF
27	Cerro Blanco	1	-2.186504	-80.017525	26/11/2020	Forest	Jay Parker	Ebird
28	Cerro Blanco	1	-2.181181	-80.021065	17/10/2020	Forest	Daniel López	Ebird
29	Cerro Blanco	1	-2.181181	-80.021065	17/10/2020	Forest	Roger Valencia Monroy	GBIF/ iNaturalist
30	Av. 25 de Julio, Guayaquil	1	-2.225363	-79.898537	16/8/2020	Urban, Highly intervened	Carlos Saldaña Carrillo	iNaturalist

N°	Locality	Individual count	Latitude	Longitude	Event date (d/m/y)	Habitat type	Bird-watcher name	Source
31	Cerro Blanco	1	-2.181181	-80.021065	12/6/2020	Forest	Roger Valencia Monroy	iNaturalist
32	La Prosperina	1	-2.155901	-79.975746	8/11/2019	Forest	Gustavo Maenz	Ebird
33	La Prosperina (Cueva de los Monos)	1	-2150596	-7997801	2/11/2019	Forest	Roger Valencia Monroy	Ebird
34	Cerro Blanco	1	-2.181181	-80.021065	22/10/2019	Forest	Unavailable	GBIF
35	Reserva Producción Fauna Manglares El Salado (Estero Puerto Hondo)	1	-2194569	-80017395	6/9/2019	Forest	Gustavo Maenz	Ebird
36	La Prosperina	1	-2.155901	-79.975746	19/8/2019	Forest	Roger Valencia Monroy	GBIF/ iNaturalist
37	La Prosperina	1	-2.155901	-79.975746	25/7/2019	Forest	Roger Valencia Monroy	iNaturalist
38	Las Esclusas, Guayaquil	1	-2.264118	-79.86895	19/7/2019	Urban, Highly intervened	Gustavo Maenz	Ebird
39	Cerro Blanco	1	-2.181181	-80.021065	4/7/2019	Forest	Unavailable	GBIF
40	La Prosperina	1	-2.155901	-79.975746	21/6/2019	Forest	Roger Valencia Monroy	Ebird
41	Cerro Blanco	2	-2.181181	-80.021065	4/5/2019	Urban, Highly intervened	Unavailable	GBIF
42	Puente 5 de Junio, Guayaquil	1	-2.186319	-79.898535	13/12/2018	Forest	César Vega Tumbaco	iNaturalist
43	Cerro Blanco	1	-2.181181	-80.021065	26/8/2018	Forest	Unavailable	GBIF
44	Cerro Blanco	1	-2.181181	-80.021065	23/8/2018	Forest	Unavailable	GBIF
45	Malecón del Salado and surroundings *	1	-2.185991	-79.898415	14/1/2018	Urban, Highly intervened	Daniel Martínez	Ebird
46	Malecón del Salado and surroundings*	1	-2.185991	-79.898415	13/1/2018	Urban, Highly intervened	Daniel Arias Cruzatti, Jorge Luis del Hierro	Ebird
47	Isla Santay	1	-2.19917162	-79.8585248	28/12/2017	Forest	Michael Bakker Paiva	iNaturalist
48	Isla Santay	1	-2.221130	-79.854900	10/10/2017	Forest	Daniel López Condoy	Ebird
49	Cerro Blanco	1	-2.181181	-80.021065	26/9/2017	Forest	Unavailable	GBIF
50	Isla Santay	1	-2.221130	-79.854900	13/6/2017	Forest	Daniel López Condoy	Ebird
51	Cerro Blanco	+	-2.181181	-80.021065	24/4/2016	Forest	Unavailable	GBIF
52	Cerro Blanco	1	-2.181181	-80.021065	9/4/2016	Forest	Roger Valencia Monroy	Ebird
53	Parque Lago	+	-2.233372	-80.12764	31/3/2016	Forest	Javier López	Ebird
54	Isla Santay	1	-2.221130	-79.854900	22/10/2015	Forest	Eduardo Zavala B.	Ebird
55	Isla Santay	2	-2.221130	-79.854900	19/9/2014	Forest	Eduardo Zavala B.	Ebird
56	Cerro Blanco	1	-2.181181	-80.021065	20/11/2010	Forest	Unavailable	GBIF
57	Cerro Blanco	2	-2.181181	-80.021065	25/11/2009	Forest	Michael Bakker Paiva	iNaturalist
58	Cerro Blanco	+	-2.183449	-80.01629	9/11/2009	Forest	Carlos Saldaña Carrillo / Francisco Enríquez	iNaturalist
59	Cerro Blanco	2	-2.181181	-80.021065	1/8/2007	Forest	César Vega Tumbaco	iNaturalist / Ebird

suggest that this species is adaptable to synanthropic environments, presumably for the available food and less competition with another hawk, especially for young individuals (Tapia & Zuberogoitia 2018); however, it is necessary to complement the ecology knowledge of this species with studies of habitat use, as well as the degree of dependence of this species on natural habitats (Rullman & Marzluff 2014).

Diet reports in raptors are very scarce in Ecuador, only a few reports are known from pellets of nocturnal raptors as owls (Brito et al. 2015, Freile et al. 2012, Moreno 2010). The urban areas of the city of Guayaquil, and its surrounding natural areas provide an important logistical facility to develop these observations, so it is advisable to continue monitoring or participating in citizen science approach to complement and add more information on the ecology and diet of raptors.

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Agradecimientos / Acknowledgments:

DAC thanks Jorge Luis Vélez Del Hierro for his assistance during the bird count at Malecón Universitario. JAS thanks Erika Sandoval for her coordination with Universidad de Las Artes and Ministerio de Salud Pública to access to old prison of Guayaquil.

Conflicto de intereses / Competing interests:

The authors declare no conflict of interest.

Rol de los autores / Authors Roles:

JAS: Conceptualization, Investigation, Writing – original draft, writing, Writing – review & editing.

DA-C: Conceptualization, Investigation, Writing – original draft, writing, Writing – review & editing.

MA-G: Conceptualization, Investigation.

CB: Conceptualization, Investigation.

RM: Conceptualization, Investigation.

Fuentes de financiamiento / Funding:

This research received no specific grant from any funding agency, commercial or not-for-profit sectors.

Aspectos éticos / legales; Ethics / legals:

Authors declare that they did not violate or omit ethical or legal norms in this research.