



Morphology and reproduction of the common opossum (*Didelphis marsupialis*) dwelling in urban vs. rural environments in Antioquia, Colombia

*Morfología y reproducción de la zarigüeya común (*Didelphis marsupialis*) que habita en ambientes urbanos vs. rurales*

*Morfologia e reprodução do gambá comum (*Didelphis marsupialis*) que vive em ambientes urbanos vs. rurais*

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Abstract

Background: Although urban wildlife has increased during the last years, the effects of urbanization on wildlife are poorly understood. Common opossum (*Didelphis marsupialis*) is a frequent dweller of the Metropolitan Area of Valle del Aburrá (AMVA) in the Antioquia province (Colombia) where opossum-human conflicts result in large numbers of injured or dead opossums. **Objective:** To evaluate the effects of urban and rural habitats on the morphometry and reproductive output (litter size in marsupium) of opossums. **Methods:** A total of 131 opossums were captured: 94 in the AMVA, and 37 in rural areas of Antioquia. Opossums were weighed, measured, sexed, clinically inspected, and photographed. **Results:** Urban opossums were heavier and larger than rural individuals, regardless of sex, and no differences were observed in terms of reproductive output between both habitats. Additionally, urban opossums were more abundant than rural opossums, possibly explained by the fact that cities favor survival -through higher food availability- but not reproduction. Alternatively, bigger animals could also be explained by inadequate diets rich in carbohydrates which may also have deleterious health effects. We observed sexual size dimorphism in head and tail length but not in body length of opossums. **Conclusion:** We confirm that urban environments have a significant effect on body mass and size of opossums; however, it is unknown whether this is beneficial or detrimental for these animals. Finally, we report the lowest litter size for the species, with no difference between rural and urban habitats.

Keywords: body size; common opossum; *Didelphis marsupialis*; human-opossum conflict; litter size; marsupial; sexual dimorphism; urban wildlife.

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Resumen

Antecedentes: La fauna silvestre urbana ha aumentado durante los últimos años. Sin embargo, el efecto de la urbanización sobre ella ha sido pobremente estudiado. La zarigüeya común (*Didelphis marsupialis*) es muy frecuente en el Área Metropolitana del Valle de Aburrá (AMVA) en Antioquia, Colombia, donde hay un fuerte conflicto humano-zarigüeya que resulta en un alto número de zarigüeyas heridas o muertas. **Objetivo:** Evaluar el efecto del hábitat urbano vs. rural sobre la morfometría y capacidad reproductiva -número de crías en el marsupio- de las zarigüeyas. **Métodos:** Un total de 131 zarigüeyas fueron capturadas: 94 en el AMVA y 34 en áreas rurales del Departamento de Antioquia. Las zarigüeyas fueron pesadas, medidas, sexadas, evaluadas clínicamente y fotografiadas. **Resultados:** Las zarigüeyas urbanas resultaron más pesadas y largas que las rurales, independientemente del sexo, y no se encontró diferencia en la capacidad reproductiva entre los dos hábitats. Además, las zarigüeyas urbanas fueron más abundantes que las rurales. Una posible explicación es que las ciudades favorecen su supervivencia -mediada por una mayor disponibilidad de comida- pero no su reproducción. Alternativamente, el mayor tamaño corporal podría deberse a un mayor consumo de carbohidratos, lo cual puede tener efectos negativos sobre la salud. También confirmamos dimorfismo sexual de la longitud de cabeza y cola, pero no del tronco de las zarigüeyas. **Conclusión:** Confirmamos un efecto del ambiente urbano sobre el peso y talla de las zarigüeyas. Sin embargo, se desconoce si dicho efecto es beneficioso o perjudicial para estos animales. Finalmente, el tamaño de camada es el más bajo reportado para esta especie, sin diferencias entre hábitat rural y urbano.

Palabras clave: conflicto humano-zarigüeya; *Didelphis marsupialis*; dimorfismo sexual; fauna silvestre urbana; marsupial; tamaño corporal; tamaño de camada; zarigüeya común.

Resumo

Antecedentes: A fauna urbana tem aumentado nos últimos anos, no entanto, o efeito da urbanização sobre ela é pouco conhecido. O gambá comum (*Didelphis marsupialis*) é muito comum na Área Metropolitana do Valle del Aburrá (AMVA), em Antioquia, Colômbia, onde também existe um conflito gambá-humano que resulta em um grande número de gambás feridos/mortos. **Objetivo:** Avaliamos os efeitos dos habitats urbano e rural na morfometria e produção reprodutiva (filhotes em marsúpio) de gambás. **Métodos:** Um total de 131 gambás foram capturados, 94 da AMVA e 37 da zona rural de Antioquia. Gambás foram pesados, medidos, sexados, clinicamente inspecionados e fotografados. **Resultados:** Os gambás urbanos foram mais pesados e longos do que os indivíduos rurais, independentemente do sexo, e não houve diferenças em relação à produção reprodutiva entre os dois habitats. Além disso, os gambás urbanos foram mais abundantes do que os gambás rurais. Uma possível explicação para esses resultados é que as cidades favorecem a sobrevivência mediada pelo maior consumo de alimentos, mas não a reprodução. Alternativamente, animais maiores também podem ser explicados por um consumo inadequado de alimentos ricos em carboidratos que podem ter potenciais consequências negativas para a saúde. Confirmamos o dimorfismo sexual de tamanho do gambá comum nos comprimentos da cabeça e da cauda, mas não no comprimento do corpo. **Conclusão:** Confirmamos um efeito significativo dos ambientes urbanos na massa corporal e no tamanho dos gambás, porém não se sabe se é benéfico ou prejudicial. O tamanho da ninhada é o menor relatado para a espécie e não houve diferenças entre habitats rurais e urbanos.

Palavras-chave: conflito homem-gambá; *Didelphis marsupialis*; dimorfismo sexual; gambá comum; fauna urbana; marsupial; tamanho da ninhada; tamanho do corpo.

Introduction

Humans have altered most ecosystems on the planet, with negative consequences for the wildlife (Bradley and Altizer, 2006; Wright *et al.*, 2012). Urban habitats are human-dominated ecosystems (Mcintyre *et al.*, 2000) that, nevertheless, provide food and shelter for a range of species. The effects of urbanization on wildlife have been studied on birds and mammals in North America, Europe, and Australia, but they are almost unknown in South America where urbanization is rapidly increasing (Magle *et al.*, 2012; Collins *et al.*, 2021).

Empirical studies have shown that wildlife species increase body condition in urban settings. For example, urban opossums (*Didelphis virginiana*) in Missouri, urban males of Silver Gulls (*Larus novaehollandiae*) in Australia, and urban wild boars (*Sus scrofa*) in Spain were heavier and/or had better body condition than their rural counterparts (Auman *et al.*, 2008; Wright *et al.*, 2012; Castillo-Contreras *et al.*, 2021). On the other hand, other studies have documented negative effects of urbanization on wildlife. For example, urban red squirrels (*Sciurus vulgaris*) prefer non-natural food items and higher sugar intake, increasing body mass, with higher health risks (Wist *et al.*, 2022). Another study reported that urban grey squirrels (*Sciurus carolinensis*) have higher blood glucose, electrolyte unbalances, and lower albumin/globulin ratio compared to rural individuals. Thus, a faster increase in body mass may be either beneficial or associated to poorer physiological conditions (Schmidt *et al.*, 2019).

One of the largest wild mammals found in Colombian urban environments is the common opossum (*Didelphis marsupialis*). This is a medium-size marsupial (up to 1,700 g of body weight; Tyndale-Biscoe and Mckenzie, 1976), generalist, and very resourceful. Unfortunately, people mistake them for big rats and mistreat them oftenly (Flórez-Oliveros and Vivas-Serna, 2020). Consequently, there is a strong human-opossum conflict in Antioquia. To illustrate this, the wildlife rehabilitation center of Corporación Autónoma Regional de las Cuencas de los Ríos Negro y Nare

(CORNARE) received 604 birds, 568 mammals, and 171 reptiles in 2020. Out of the total mammals, 74% (n=421) were common opossums. Not only the number of opossum entries to wildlife health or rehabilitation centers increases year after year (Table 1), but also the number of opossums is more than four times higher in urban (Area Metropolitana del Valle de Aburrá, AMVA) than in rural areas (CORNARE).

We tested if urban habitats provide benefits to opossums to compensate such conflict. We expected that urban environments provided more food resources to opossums than rural areas; then, urban opossums would be heavier and larger than their rural counterparts. In such scenario we would also expect that this potentially may translate into higher reproductive output (i.e., heavier or larger females would have increased litter size).

Materials and Methods

This study was approved by the Ethics Committee for the Experimentation with Animals (CEEA) of Universidad de Antioquia (Act 126 of August 13, 2019; Act 135 of September 8, 2020; and Act 143 of December 7, 2021). Additionally, a wildlife collection permit issued by the National Authority of Environmental Licenses (ANLA) to Universidad de Antioquia was obtained to conduct the study (Resolution 1461 of December 3, 2014).

Study area

The study was conducted in seven municipalities of the Antioquia province, Colombia (Table 2). Bello, Medellín, Envigado, Itagüí, and La Estrella municipalities are located from north to south, respectively, along the Aburrá river on the western side of the Colombian Central Mountain Range, in the Metropolitan Area of Valle de Aburrá. These municipalities are heavily urbanized, with human population densities between 1,939 and 14,182 people/km². In this municipalities there are six urban parks frequently visited for recreation by people and pets: Piamonte in Bello; Asomadera, el Volador, and Nutibara in Medellín; Heliadora in Envigado; and Ditaires in Itagüí (Figure 1).

Table 1. Number of common opossums (*Didelphis marsupialis*) received at the wildlife health and rehabilitation centers of Corporación Autónoma Regional de las Cuencas de los Ríos Negro y Nare (CORNARE) and Area Metropolitana del Valle de Aburrá (AMVA), in Antioquia, Colombia, between 2019 and 2022 (data provided by CORNARE and AMVA).

Outcome/year	2019	2020	2021	2022	Total	%
CORNARE (rural center)						
Died/euthanized	61	210	375	463	1109	59.7
Released/relocated	72	195	209	171	647	34.8
Other (escaped or still in rehabilitation)	0	16	29	58	103	5.5
Total	133	421	613	692	1859	100
AMVA (urban center)						
Died/euthanized	720	1017	1308	1504	4549	52.2
Released/relocated	914	1042	971	1082	4009	46.0
Other	28	10	19	100	157	1.8
Total	1662	2069	2298	2686	8715	100

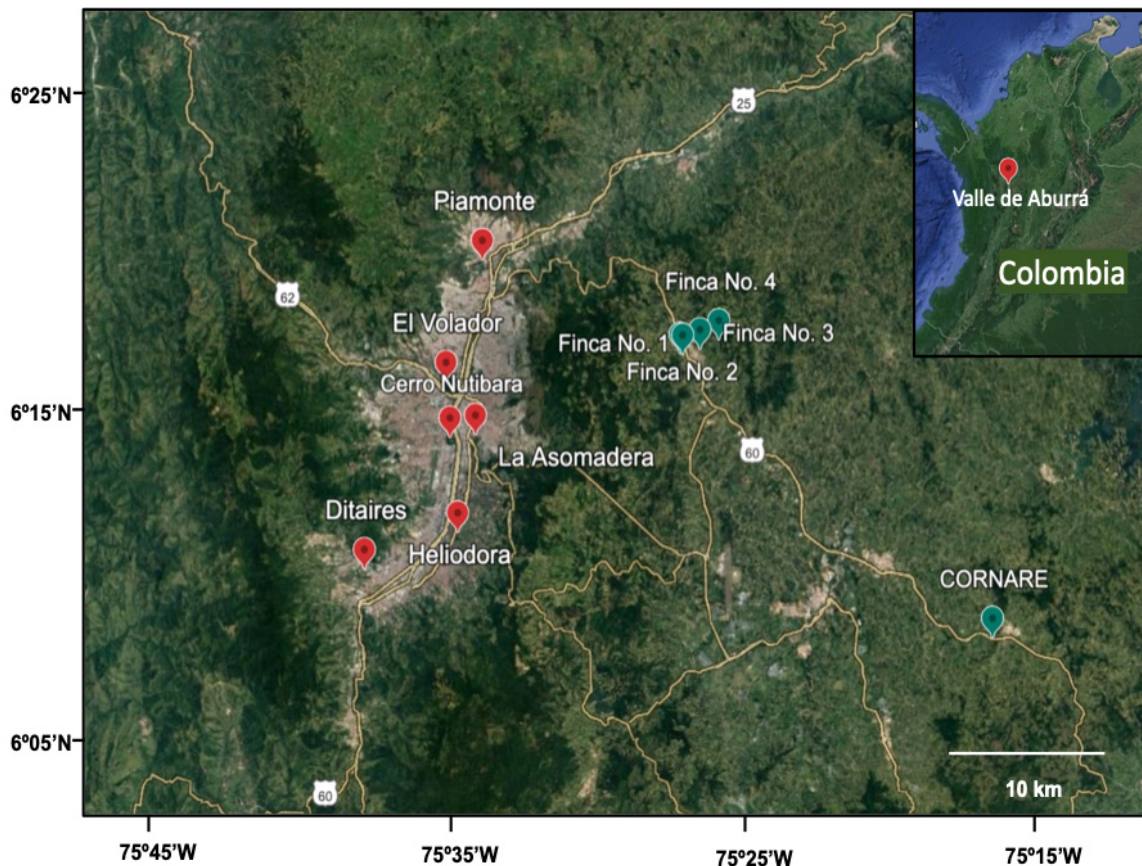


Figure 1. Location of six urban parks (red tags: Piamonte in Bello, El Volador, Cerro Nutibara and La Asomadera in Medellín; Ditaires in Itagüí; and Heliadora in Envigado,) within the Metropolitan Area of Valle de Aburrá (inset in upper right corner), and private farms in rural areas (green tags) in Antioquia, Colombia, where common opossums were captured.

These parks host a variety of wildlife, including the common opossums trapped during this study.

In addition to these urban parks, we also trapped opossums in rural areas of Guarne and Santuario municipalities (handed in by CORNARE -the local environmental authority). These rural areas hold a much lower human population density, below 404 people/km², and are formed mainly by private farms that base their economy on crops of blackberries, potatoes, beans, and strawberries, along with livestock species, namely cows, pigs, and trout.

Animal capture

We set traps to capture opossums in urban and rural habitats. Captures in urban areas were conducted from October 2020 to August 2021 by installing six Tomahawk traps in the six urban parks. Traps were baited with fresh pork viscera or canned sardines, and they were left 20 nights on each park. To increase sample size, we set up six additional Tomahawk and three pitfall traps at the Escuela de Medicina Veterinaria campus of Universidad de Antioquia and surroundings next to El Volador urban park in November and December 2022. The pitfall traps (as described in Glebskiy and Cano-Santana, 2021) were implemented to prove a different capture method because some opossums were very stressed into the Tomahawk traps and hurt themselves by biting the wire -in spite that traps were checked

every day early in the mornings. These additional traps were baited with cooked eggs and cat food. The total capture effort in urban areas was 876 traps/night.

Captures in rural areas were conducted from May to December 2022 by installing 12 Tomahawk traps in an opportunistically manner in six rural farms located in Guarne municipality. The owners of private farms gave us permission to install the traps in their properties and helped with baiting and checking the traps early every morning. The capture effort in rural areas was 813 traps/night. In addition, we included data of two healthy individuals that were recovered by the local environmental authority (CORNARE) in Santuario municipality.

Data collection

Once an opossum was trapped, we manually immobilized it using leather gloves. All animals were sexed, weighed (g), and measured (cm). The measurements taken were total body length (head length + body length + tail length) along the body midline with a metric tape, and head linear length, and head linear width with a caliper. In females, the number of pouch young (reproductive output) were recorded, if any. Also, the mammary gland was recorded as “active” if it was enlarged and/or secreting milk after teat pression, or “inactive” if it was flattened and no young were found in her pouch.

Table 2. Municipalities in Antioquia province, Colombia, where opossums were captured. Human population density is projected from the 2018 national census to 2022 (DANE, 2023). Notice the difference in human population density between urban and rural habitats.

Municipality	Altitude	Mean temperature (°C)	Area (km ²)	Population density in 2022 (people/km ²)	Subregion of Antioquia	Habitat
Itagüí	1.550	21	21	14.182	Valle de Aburrá	Urban
Medellín	1.479	23	376	6.942	Valle de Aburrá	Urban
Bello	1.310	22	149	3.822	Valle de Aburrá	Urban
Envigado	1.675	21	79	3.171	Valle de Aburrá	Urban
La Estrella	1.775	20	35	1.939	Valle de Aburrá	Urban
Santuario	2.150	17	75	404	Oriente	Rural
Guarne	2.150	17	151	397	Oriente	Rural

All individuals were marked by shaving a skin area of approximately 2×1 cm in the lateral side of the left thigh. Trapped animals with shaved skin were recorded as recaptures and were identified using previous photographs and data records. Finally, the animals were released at the same capture site within approximately 30 minutes.

Data analysis

We conducted analyses of variance using linear models to test for differences in body weight and length between the two types of habitat and sexes. Sex was used as a cofactor (ANCOVAS) given that sexual dimorphism of *D. marsupialis* has been reported in skull length and body weight of subadults and adults in Colombia (i.e., males are bigger than females; Tyndale-Biscoe and Mackensie 1976). We also tested altitude as a potential confounding effect given that rural areas were located at higher altitude compared to urban areas. Finally, a two-sided Mann-Whitney test was conducted to know if the number of pouch young between rural and urban habitats were similar (null hypothesis) or different (alternative hypothesis).

Sex ratio was estimated considering that it may affect the reproductive output of a population. We assumed there was no movement of individuals between municipalities because the home range size of opossums has been estimated as 0.3 ha (Sunquist *et al.*, 1987), thus sex ratios were estimated per municipality. Using the observed sex ratio, the probability of the expected sex ratio at each site was estimated with a logistic regression model and then the marginal mean was estimated. If the 95% confidence interval (CI) of the estimated means included 0.5, then the sex ratio was considered statistically unbiased. This analysis was done using the *emmeans* package in the R environment (Lenth, 2023).

Results

Animal captures

A total of 183 captures were conducted, corresponding to 131 different opossums (52 recaptures) consisting of 94 urban and 37 rural

opossums. Considering only different individuals, the capture success in urban areas (0.107) was 2.3 higher than that in rural areas (0.046). Almost all captures were done in the tomahawk traps and a small number of individuals (n=4) were captured in the pitfall traps installed at Escuela de Veterinaria of Universidad de Antioquia.

Regarding sex, 60 were females and 71 males. In terms of life stages, 15 (11%) were juveniles under 450 g, 16 (12%) were subadults between 450 and 800 g, and 100 (76%) were adults above 800 g body weight. The smallest opossum recorded was a 50 g male measuring 25.98 cm total body length found strolling around a gas station (Guarne municipality), followed by six others under 150 g, which suggests a litter weaned at early age.

Observed sex ratios were calculated using all life stages discriminated by municipality, except for three of them with low sample size (Envigado, La Estrella, and Santuario). Sex ratios at Itagüí, Medellín, and Guarne were not statistically different from 1:1, thus all were unbiased (Table 3).

Effects of habitat (rural vs. urban) on body size and length

Regardless of sex, urban opossums were heavier than rural opossums (ANCOVA, habitat: $F_{1,127}=7.786$; $p<0.007$; sex: $F_{1,127}=3.823$; $p>0.052$). This is, median body weight was 1550 g (average=1554.5; range=106.5–3450; SD=735.5) for urban opossums, and 1203 g (average=1153.2; range=50–2706; SD=758.5) for rural opossums. Likewise, regardless of sex, urban opossums were longer than rural opossums (ANCOVA, habitat: $F_{1,123}=5.8161$; $p<0.0174$; sex: $F_{1,123}=0.0388$; $p>0.844$). Median total body length was 38.35 cm (average=37.23; range=16.5–48.0; SD=6.02) for urban, and 36.75 cm (average=33.73; range=12.8–57.0; SD=9.87) for rural opossums. In addition, altitude alone had a significant effect on body weight ($F_{1,128}=5.037$; $p<0.0266$), and body length ($F_{1,124}=4.7205$; $p<0.0318$), with opossums from lower altitudes being heavier and longer; however, the regression

coefficient was low in both cases ($R^2_{\text{body weight}}=0.0378$; $R^2_{\text{body length}}=0.0366$) indicating that variability of data points was high, thus the altitude factor should be considered minor.

Sexual dimorphism

Sex had a significant effect on morphometry of adult opossums (above >800 g; Table 4), with adult males heavier and longer compared to adult females. On average, males weighed 2,000.4 g and total body length was 92.4 cm, while females weighed 1,518.8 g and measured 87 cm. Interestingly, when total body length was discriminated by anatomical components, head and tail were longer in males, but there was no difference in body length between males and females. Head size was also sexually dimorphic, being larger and wider in males compared to females.

Reproductive output

Out of the 60 total females captured, 17 (28%) had pouch young, 10 (17%) did not have young but had the mammary gland active (suggesting

they were reproductively active in a recent lactation), and the remaining 33 (55%) showed no clinical signs of pregnancy or lactation. The average litter size (number of young in the pouch) was 3.94 and varied from 2 to 7 (SD=1.39). The smallest female weighed 770 g with two young, and the largest female weighed 2,200 g with three young. The female with the largest litter size, seven young, weighed 2,050 g.

Discriminating by type of habitat, out of the 45 urban females, 34 did not have pouch young and the 10 remaining females had between two and seven young for a mean litter size of 4.09. On the other hand, out of the 15 rural females, nine had no pouch young, and the remaining six had between two and six young for a mean litter size of 3.67. In summary, there were more non-reproductive females in urban (75.5%) than in rural habitats (60%), but this difference was not statistically significant (Mann-Whitney $W=384.5$; $p=0.3175$). Although we did not make efforts to trap opossums every month of the year, we observed females with pouch young during most months except for January, February, July, and November.

Table 3. Number of opossums (*Didelphis marsupialis*) captured in urban and rural areas, discriminated by municipality, life stage, and sex.

Habitat	Municipality	Juvenil		Subadult		Adult		Total		Observed sex ratio (F:M)	Estimated probability of sex ratio (F:M)	95% confidence interval
		F	M	F	M	F	M	F	M			
Urban	Itagüí	-	1	-	-	12	10	12	11	1,09	0,478	(0.288–0.675)
	Medellín	1	3	4	4	15	22	20	29	0,69	0,592	
	Bello	1	-	1	2	6	6	8	8	1	NA	(0.451–0.719)
	Envigado	1	-	-	-	3	2	4	2	2	NA	
	La Estrella	-	-	-	-	1	-	1	0	NA	NA	
Rural	Santuario	-	-	-	1	1	-	1	1	1	NA	(0.419–9.739)
	Guarne	3	5	-	4	11	11	14	20	0,70	0,588	
Overall		6	9	5	11	49	51	60	71	0,85		

F=females, M=males, NA=not calculated because of the small sample size, or the observed ratio was 1. Sex ratios were statistically unbiased because 0,50 is included in the 95% confidence intervals.

Table 4. Sexual dimorphism in body weight (g) and length (linear and curve, cm) of adult (> 800 g) opossums (*Didelphis marsupialis*) in Antioquia, Colombia.

Measurement	Females				Males				Sexual dimorphism
	Mean	n	Range	SD	Mean	n	Range	SD	
Body weight	1514.5	49	890–2400	351.4	2000.4	50	890–3450	627.0	Yes ($F_{1,97}=22.3$; $p<0.0001$)
Head linear length	10.3	41	7–12.7	1.1	11.4	42	8.8–14.3	1.2	Yes ($F_{1,91}=21.3$; $p<0.0001$)
Head linear width	5.1	41	4–6.6	0.5	6.0	42	4.3–8.1	0.8	Yes ($F_{1,92}=34.1$; $p<0.0001$)
Total body curve length:	87.1	46	68–107.5	8.1	92.0	48	66–109.5	9.3	Yes ($F_{1,93}=7.6$; $p<0.0071$)
Head length	11.0	43	6–14	1.6	12.1	46	9–15	1.5	Yes ($F_{1,89}=9.2$; $p<0.0031$)
Trunk length	38.6	46	27–53	5.5	40.4	46	30–54	6.3	No ($F_{1,93}=3.1$; $p>0.08$)
Tail length	38.3	46	26–43.5	3.4	39.9	47	32–48	3.6	Yes ($F_{1,92}=4.3$; $p<0.041$)

SD=Standard deviation.

Discussion

We evaluated the effects of urban vs rural habitats on morphometry and reproductive output (litter size in marsupium) of opossums, finding that urban opossums were heavier and longer than rural opossums. The reason why urban opossums are bigger is unknown, but body size probably varies with local conditions. Urban *D. virginiana* opossums in Missouri, USA, were one third heavier than rural individuals (Wright *et al.*, 2012), but urban *D. marsupialis* in Caracas, Venezuela, were lighter than suburban opossums during the dry season (Cordero-Rodríguez, 2000). Urban environments may offer more resources, and the home-range may be smaller than those in rural habitats; thus, opossums may require less energy to find food (Wright *et al.*, 2012).

Being bigger does not necessarily means being better. *Didelphis marsupialis* is an omnivorous species (Cordero-Rodríguez, 2000; Tardieu *et al.*, 2020), but also garbage has been found in the stomach of *D. marsupialis* in urban environments (Adler *et al.*, 1997; Cordero-Rodríguez, 2000). Similarly, urban *D. virginiana* is omnivorous but they also may eat nonnatural food such as pet food or garbage (Hopkins and Forbers, 1980). Urban squirrels consume more carbohydrates and fat compared to their rural counterparts, which alter their health perhaps mediated by a greater

stress compared to rural individuals (Schmidt *et al.*, 2019). Given these empirical studies on urban wildlife, it would be interesting to conduct paraclinical examinations comparing the health status of urban opossums in the Metropolitan Area of Valle de Aburrá (Schmidt *et al.*, 2019; Wist *et al.*, 2022) with that of rural opossums.

Regarding reproduction, we found no difference in the reproductive output of urban vs. rural females, nor it was correlated with female size. The average litter size in this study is the lowest reported for the species. We found 3.94 offspring (range=2–7; n=17 females), while litter size was 4.49 (SD=1.36; n=41) in Valle del Cauca (Colombia), 6.5 (range=1–11; SD=2.19; n=37) in eastern Colombia (Tyndale-Biscoe and MacKenzie, 1976), and 6.8 (range=4–10; n=20) in Caracas, Venezuela (Cordero-Rodríguez, 2000). Litter size should be restricted to the number of nipples since females cannot sustain more younger than their available number of nipples. In our study, we observed that the number of nipples varied from 1 to 7 suggesting that it changes through ontogeny or according to the reproductive stage of the mother. Unfortunately, this data was not recorded systematically in our study. We suggest future studies should address this matter. In addition, it should be noted that females may reproduce several times during the

year (Rademaker and Cerqueira, 2006), thus, to estimate annual fecundity would require longer and more systematic studies.

Given that capture success was more than 20 times higher in metropolitan than in rural areas (0.081 vs. 0.004) opossums are regarded more abundant in urban habitats. An alternative explanation for the higher capture success in cities is that home range is reduced compared to rural habitats (Wright *et al.*, 2012) with potential barriers that limit their movements (e.g., higher roadkill) (Cáceres, 2000), thus opossums may be forced to recirculate near the traps more often. Nevertheless, *D. marsupialis* have been found abundant in low disturbance areas with natural patches (Cruz-Salazar *et al.*, 2014) as is the case of the present study. A similar finding was already reported in a study conducted in the Metropolitan Area of Valle de Aburrá (Rodríguez *et al.*, 2022).

Another interesting finding of this study was that sexual size dimorphism skewed towards males (i.e., body mass, total length, head length, and head width were higher/larger in males compared to females). Males of *D. marsupialis* and *D. virginiana* had strong bite force and exhibit male-to-male combat, thus sexual selection explains their larger head compared to females (Cervantes and Oviedo-Martínez, 2020; Bubadué *et al.*, 2021). Sexual dimorphism in tail length, however, is less understood. Virginia opossums are now more terrestrial than arboreal compared to its ancestors, and prehensibility of the tail for climbing seems to have been reduced (Hazimihalis *et al.*, 2012). Similarly, *D. marsupialis* is, probably, more terrestrial and uses its tail more often for grasping materials than for maneuvering during locomotion (McManus, 1970; Hazimihalis *et al.*, 2012). Further research is needed to explain why males have longer tails compared to females.

Finally, pitfall traps were installed at one site (Universidad de Antioquia). This method was innocuous for the opossums, as they were found sleeping in the mornings with no hurting signs -as was the case with the Tomahawk traps. We encourage future researchers to use pitfall traps

to capture opossums and to systematically test different baits, different sites, and duration times of the traps installed in the same site.

In conclusion, urban environments were associated to larger, heavier, and more abundant opossums, but there was no difference regarding reproductive output between urban and rural habitats. We suggest that cities may favor survival through potentially higher food consumption, but not reproduction. Environmental authorities and academia should reinforce education of the public on the biology and benefits of urban wildlife as a measure to alleviate the severe human-opossum conflict developing in Antioquia, Colombia.

Declarations

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Conflict of interest

The authors declare they have no conflicts of interest regarding the work presented in this report.

Author contributions

The study was designed by CC, field work data were collected by CC, VH, and JC. The first draft was written by CC and all authors commented the discussion section. All authors read and approved the final version.

Use of artificial intelligence (AI)

No AI or AI-assisted technologies were used during the preparation of this work.

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