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An Updated Inventory and Habitat Association Analysis of the Non-avian Vertebrates of the University of the Philippines (UP) Diliman

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ABSTRACT

An inventory of the non-avian terrestrial vertebrate species found within the 493-hectare land area of the UP Diliman campus is presented. Visual encounter surveys for amphibians and reptiles, as well as mist-netting and trapping for mammals, were conducted last August 2019 to early February 2020 on selected study grids on campus. To determine habitat associations, the species richness of each vertebrate class (i.e., amphibia, reptilia, and mammalia) was analyzed with habitat characteristics of the grid using regression analysis. Based on the surveys and recent records (2015 onwards) in literature, a total of 33 species were recorded: seven amphibians, 15 reptiles, and 11 mammals. Comparison with historical records from 1998 revealed that an additional two amphibian species, seven reptile species, and six mammalian species have been sighted within the area since 2015. However, a fork-tongued frog, falling under the genus *Fejervarya*, and four reptilian species that had previously been recorded within the study sites were not observed. Habitat association analysis revealed that building area is correlated with species richness, with reptilian species richness being positively correlated with it. Overall, this study shows that the UP Diliman campus supports considerable urban biodiversity despite recent developments.

Keywords: urban biodiversity, amphibian diversity, reptile diversity, mammal diversity

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INTRODUCTION

The global increase of the human population lends itself to rapid urbanization, with urbanized areas becoming the most rapidly expanding habitat type worldwide (Faeth et al. 2011). Currently, 55% of the world's population resides in urban areas, and this number is expected to increase to 68% by 2050 (United Nations 2019). This rapid urbanization entails the conversion of natural green spaces into man-made infrastructures (e.g., roads, houses) and fragmentation of habitats, which are associated with biodiversity loss and environmental degradation (Müller et al. 2013). Amidst these threats, pockets of green spaces serve as refuges where flora and fauna can thrive within urban landscapes (Pickett et al. 2001).

Urban ecosystems, along with their associated biodiversity (Nilon 2011), provide numerous ecosystem services (Edwards et al. 2020). These services are derived from the interactions between different species and between species and their environment, such as seed dispersal, pollination, pest control, and the like (Montoya et al. 2012). With most people now living in cities, these biodiversity-derived services are influenced by anthropogenic activities, with alterations to species composition, abundances, richness, and evenness tied to changes in their habitat (Faeth et al. 2011; Nilon 2011).

The University of the Philippines Diliman (UPD) campus is one of the last remaining green spaces in Metro Manila. The 493 hectares of land within its bounds provide habitats for a diversity of plant and animal species within the surrounding 'sea' of urban infrastructure. A survey conducted by Ong et al. (1999) revealed the campus to be home to over 50 unique vertebrate fauna including six amphibian species, nine reptilian species, 38 bird species, and eight mammalian species. After more than a score, these numbers have become outdated given new species records and potential species loss (Vallejo and Aloy 2014). Much of the landscape has changed as well, with many new infrastructures and other campus developments.

This study aims to provide an updated inventory of non-avian vertebrate fauna found within the UP Diliman campus, as well as to determine general species-habitat associations. This would highlight the importance of green spaces for wildlife as well as provide information that can guide land-use management and maintenance practices of the campus to better conserve urban biodiversity.

METHODOLOGY

The 493-hectare UPD campus is located in Quezon City, National Capital Region. The city ranks as the most populous among the 16 highly urbanized cities in the region based on the 2020 census (Philippine Statistics Authority 2021). The campus was acquired in 1939 but was officially used a decade after when the administration was transferred from the old campus in Manila (University of the Philippines Diliman n.d.a). Since then, numerous buildings have been built to support the university's functions, and the campus now has more than 900 buildings (University of the Philippines Diliman n.d.b). Development has been guided by the 2012 Land Use Plan (Appendix 1) wherein 28% of the campus' land area has been dedicated to academic or academic support units (137.70 ha), 22.5% has been dedicated for residential use (110.87 ha), 4.4% for the campus core (21.66 ha), and 3.7% designated as a protected forest area (18.25 ha) (University of the Philippines Diliman n.d.b).

The campus map was divided into study grids measuring 250 m by 250 m in QGIS (Figure 1). Selected grids were surveyed for the presence of non-avian vertebrate

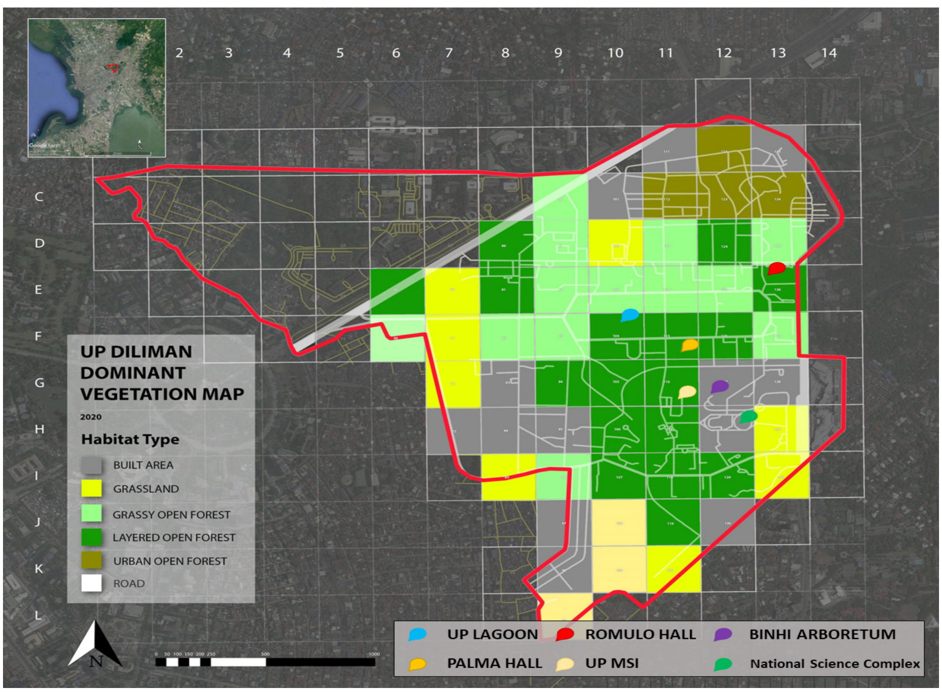

Figure 1. Dominant habitat map of UP Diliman campus (campus boundary outlined in dark red lines). The 58 study grids (in 250 m by 250 m spacing) were color-coded based on the dominant plant and building features observed within: built area (grey), grassland (yellow), grassy open forest (pale green), layered open forest (dark green), urban open forest (brown), cropland (pale yellow). White lines signify roads. Landmark areas are indicated by color coded pins: UP Lagoon (blue), Palma Hall (orange), Romulo Hall (red), UP MSI (pale yellow), Binhi Arboretum (purple), and National Science Complex (green).

fauna and classified into habitat types based on vegetation composition and built area coverage. The grids located across Commonwealth Avenue (i.e., UP Arboretum, UP-Ayala Land Technohub) and Katipunan Avenue (UP Town Center) were not included due to time and logistic constraints. Sampling events were conducted from August 2019 to early February 2020.

Habitat Sampling

In each grid, the dominant plant feature (e.g., grasses, shrubs, and trees) was determined through on-site surveys and inspection of satellite images. Additional information on each grid's canopy cover and building area was measured using satellite imagery through Google Earth (Google Earth Pro 2017). These were then used to classify the grids into the following vegetation cover classification types:

Built Area – heavily modified areas with high building footprint (i.e., 1-2 story infrastructures) and with minimal vegetation (e.g., potted plants, scattered trees) around the infrastructure

Cropland – agricultural spaces mostly planted with low crops (i.e., rice, vegetables)

Grassland – open spaces with scattered small shrubs and extensive grass cover

Grassy Open Forest – vegetated areas dominated by large trees with a few understory layer/s and abundant groundcover

Layered Open Forest – vegetated areas with multiple structural layers consisting of trees, shrubs, and groundcover

Urban Open Forest – vegetated areas with multiple layers of trees, shrubs, and groundcover interspersed with low-level infrastructures

Wildlife Survey

Amphibian, reptilian, and mammalian species records were obtained through a series of grid surveys. These were supplemented with data collected through collating recent wildlife records dating from 2015 to 2021. The sources included student thesis studies, class field exercises (i.e., Biology courses), social media (i.e., The UP Wild Facebook page), and other citizen science platforms (e.g., iNaturalist). Such reports were verified through photographs and/or specimen examination.

Grids lacking in data from these supplemental sources were prioritized in the survey effort, leading to a total of 26 grids sampled for amphibians, 23 grids for reptiles, and 15 grids for mammals. Sampling was only done during the wet season, as the Covid-19 pandemic prevented us from conducting the dry season sampling activities.

Amphibians and reptiles were surveyed using time-constrained opportunistic searches at night (Bennett 1999). At least one man-hour of survey effort was spent in each grid. On the other hand, bats were sampled using mist nets (Hoffmann et al. 2010). Two mist nets were opened in each grid from 1800H to 2100H for a total of six net hours per grid. On the other hand, non-volant mammals were captured using cage traps. Five cage traps per grid were baited with bread with peanut butter. Traps were left deployed for two nights, for a total of 10 trap nights per grid, but were checked and rebaited as needed daily. Captured mammals were released after species identification. Species encounters outside of the survey period were also noted as off-survey data. Identification was aided using field guides (Alcala and Brown 1998; Das 2015; Heaney et al. 2016). Experts from the UP Diliman Institute of Biology verified for uncertain identification.

Species-Habitat Association

Species richness per grid derived from these records was then compared against the grids' respective habitat type, canopy cover, and building area through GLM analysis with Poisson error distribution using RStudio (RStudio Team 2020). Additionally, the species richness per class (i.e., amphibia, reptilia, mammalia) was also analyzed in relation to canopy cover and building area.

RESULTS & DISCUSSION

A total of 33 unique non-avian vertebrate species comprising six amphibian families, seven reptilian families, and five mammalian families were present across 58 grids of six different habitat classifications within the campus.

Habitat Sampling

The study site was a mosaic of habitat types (Figure 1). The majority of the 58 grids were classified as layered open forests (29.3%), grassy open forests (22.4%), or built areas (22.4%). There were relatively few grids representing grasslands (14.0%), urban open forest (6.9%), and cropland (5.2%).

Wildlife Inventory

This study provided an updated campus inventory of non-avian vertebrate species (Table 1). A total of 33 species was recorded, which includes seven amphibians, 15 reptiles, and 11 mammals. Compared to the Ong et al. (1999) study, 20 new species records were added while seven species were not recorded here (Table 2). Field surveys alone revealed a total of 16 non-avian vertebrate species within the campus. Additional records were obtained from the literature review (Table 2).

Table 1. Compiled list of non-avian vertebrate species found within the UPD campus from survey efforts, conducted from August 2019 to early February 2020 (indicated by asterisk), and literature review from 2015-2021 (items without an asterisk)

Family	Common Name	Scientific Name
	Amphibians	
Bufonidae	Cane Toad *	*Rhinella marina*
Dicroglossidae	Chinese Edible Frog *	*Hoplobatrachus rugulosus*
	Common Puddle Frog *	*Occidozyga laevis*
Eleutherodactylidae	Greenhouse Frog *	*Eleutherodactylus planirostris*
Microhylidae	Banded Bullfrog *	*Kaloula pulchra*
Ranidae	Common Green Frog *	*Hylarana erythraea*
Rhacophoridae	Common Tree Frog *	*Polypedates leucomystax*
	Reptiles	
Trionychidae	Chinese Softshell Turtle	*Pelodiscus sinensis*
Emydidae	Red-eared Slider	*Trachemys scripta elegans*
Geoemydidae	Southeast Asian Box Turtle	*Cuora amboinensis*
Gekkonidae	Tender-skinned Gecko	*Gehyra mutilata*
	Brooke's House Gecko *	*Hemidactylus brookii*
	Common House Gecko *	*Hemidactylus frenatus*
	Flat-tailed House Gecko	*Hemidactylus platyurus*
	Tokay Gecko	*Gekko gecko*
Scincidae	Common Sun Skink	*Eutropis multifasciata*
	Northern Philippine Sun Skink	*Eutropis borealis*
Typhlopidae	Brahminy Blind Snake *	*Indotyphlops braminus*
Colubridae	Gervais' Worm Snake *	*Calamaria gervaisii*
	Island Wolf Snake *	*Lycodon capucinus*

Table 1. Compiled list of non-avian vertebrate species found within the UPD campus from survey efforts, conducted from August 2019 to early February 2020 (indicated by asterisk), and literature review from 2015-2021 (items without an asterisk) (Cont'n.)

	Northern Triangle-spotted Snake	*Cyclocorus lineatus*
	Philippine Rat Snake	*Coelognathus erythrurus*
	Mammals	
Pteropodidae	Cave Nectar Bat *	*Eonycteris spelaea*
	Geoffroy's Rousette	*Rousettus amplexicaudatus*
	Greater Musky Fruit Bat *	*Ptenochirus jagori*
	Lesser Short-nosed Fruit Bat *	*Cynopterus brachyotis*
	Long-tongued Fruit Bat	*Macroglossus minimus*
Emballonuridae	Black-bearded Tomb Bat	*Taphozous melanopogon*
Vespertilionidae	Java Pipistrelle	*Pipistrellus javanicus*
	Lesser Asiatic Yellow Bat	*Scotophilus kuhlii*
Sciuridae	Finlayson's Squirrel	*Callosciurus finlaysonii*
Muridae	Asian House Rat *	*Rattus tanezumi*
	Asian House Shrew	*Suncus murinus*

Table 2. A compiled list of amphibians, reptiles and mammals found within UP Diliman from 1997-1998 (Ong et al. 1999), 2019-2020 survey data, and 2015-2021 literature data

SPECIES	Oct 1997 - Aug 1998 (Ong et al. 1999)	This study	
		Aug 2019 - Feb 2020 surveys	2015-2021 Literature data
Amphibians			
Rhinella marina	x	x	
Hylarana erythraea	x	x	
Fejervarya sp.	x		
Hoplobatrachus rugulosus	x	x	
Polypedates leucomystax	x	x	
Occidozyga laevis	x	x	
Eleutherodactylus planirostris		x	
Kaloula pulchra		x	
Reptiles			

Table 2. A compiled list of amphibians, reptiles and mammals found within UP Diliman from 1997-1998 (Ong et al. 1999), 2019-2020 survey data, and 2015-2021 literature data (Cont'n.)

Gekko gecko	x		Off census encounter - 2021, Class field exercise - 2018
Hemidactylus frenatus	x	x	
Hemidactylus stejnegeri	x		Class field exercise - 2018
Hemidactylus platyurus	x		Class field exercise - 2018
Eutropis multifasciata	x		Class field exercise - 2019
Naja philipinensis	x		
Rhabdophis spilogaster	x		
Pelodiscus sinensis			Class field exercise - 2018
Trachemys scripta elegans			Class field exercise - 2018
Cuora amboinensis			Class field exercise - 2018
Gehyra mutilata			Off census encounter - 2021
Eutropis borealis			Class field exercise - 2018
Cyclocorus lineatus			Class field exercise - 2019
Coelognathus erythrurus			Verified via photograph - 2018
Hemidactylus brookii		x	
Indotyphlops braminus		x	
Calamaria gervaisii		x	
Lycodon capucinus		x	
Mammals			
Cynopterus brachyotis	*x*	x	
Ptenochirus jagori	*x*	x	
Rousettus amplexicaudatus	*x*		Class field exercise - 2017
Eonicteris spelaea	x	x	
Suncus murinus	x		Off census encounter - 2021, Class field exercise - 2019
Rattus norvegicus	x		
Rattus exulans	x		
Macroglossus minimus			Thesis study (Abdao, 2019)
Taphozous melanopogon			Class field exercise - 2018
Pipistrellus javanicus			Class field exercise - 2018
Scotophilus kuhlii			Class field exercise - 2018
Callosciurus finlaysonii			Verified via video - 2020
Rattus tanezumi		x	

*previously misidentified as *Limnonectes macrocephalus*

Amphibians

There are seven amphibian species found within the campus. All species were observed during the surveys and they belong under the families of true toads (Bufonidae), forked-tongue frogs (Dicroglossidae), rain frogs (Eleutherodactylidae), narrow-mouthed frogs (Microhylidae), true frogs (Ranidae), and tree frogs (Rhacophoridae).

Introduced species dominated the campus amphibian fauna. Out of the seven species, only the Common Tree Frog (*P. leucomystax*) and the Common Puddle Frog (*O. laevis*) are native to the country. Two new exotic species, the Banded Bullfrog (*K. pulchra*) and the Greenhouse Frog (*E. planirostris*) (Diesmos et al. 2015) have successfully established populations on campus and were encountered frequently in different sites. The former was first reported in Luzon in 2003 and was believed to have been brought by the pet trade or as a cargo stowaway (Pili et al. 2019). Its presence is conspicuous, especially during breeding season with its loud calls. On the other hand, the *E. planirostris* was first reported in Quezon City in 2014 as a stowaway in the plant trade (Sy et al. 2015), and by 2018 it was already common in the campus.

This influx of new species was accompanied by a loss of a previous, potentially endemic, species. Ong et al. (1999) reported the presence of the Luzon Fanged Frog (*Limnonectes macrocephalus*) within the UP Arboretum. However, the accompanying photograph of the species was later identified as *Fejervarya* sp. (P. Kim, personal communication with author, February 2021). Two frogs under this genus, *F. moodiei* and *F. vittigera*, are known to occur in freshwater marshes and wetlands in Luzon (Diesmos et al. 2015). Regardless, neither of the two *Fejervarya* species nor *L. macrocephalus* were encountered in our surveys or in other recent amphibian surveys (Roño 2015). The loss of this species may be attributable to a loss of suitable habitat within the campus. A study by Villasenor et al. (2017) similarly correlates a decrease in frog species richness with habitat disturbance brought about by urban development. Changes in their aquatic habitat (water body size, aquatic vegetation), as well as urbanization of the terrestrial environment within one kilometer of that aquatic habitat, have been shown to impact the presence of different frog species. The streams around which they would usually be found could have been cemented over with the construction of ripraps, leading to the species' eventual disappearance.

Reptiles

The reptilian community had the highest species richness (15 sp.) among the vertebrate classes. It is composed of three turtles, five geckos, two skinks, and five snakes. Of which, three snakes and two geckos were observed during the surveys.

Of the three turtle species in the campus found in habitats near water bodies, only the Southeast Asian Box Turtle (*C. amboinensis*) is native. It was photographed from a man-made pond at the Palma Hall and near a stream at the IB-EDC Binhi Threatened Species Arboretum. Meanwhile, the Red-eared Slider (*T. scripta elegans*) and the Chinese Softshell Turtle (*P. sinensis*) were recorded within the National Science Complex. The presence of the *T. scripta elegans* in the wild was verified from a specimen that was unexpectedly caught in a pitfall trap last 2018, while the *P. sinensis* was recorded as a dead specimen in 2018 and alive in 2019. Both turtles are introduced species, with the former most likely introduced from the pet trade and the latter from the food trade (Sy 2015).

For the geckos, all five species are known to be commensals or associated with human settlements (Bowles et al. 2019; Lwin et al. 2019; Lwin et al. 2021; Wogan et al. 2021a; Wogan et al. 2021b). They were abundant in roadside trees and artificial structures, particularly on surfaces near lighting fixtures. These areas served as their hunting grounds for insects that were attracted to the light (Zozaya et al. 2015). Of the five, only two species, the Brooke's House Gecko (*H. brookii*) and the Common House Gecko (*H. frenatus*), were verified during survey efforts. The *H. brookii* was identified by its numerous tubercles on the dorsum, while the *H. frenatus* was distinguished by its cylindrical tail with serrations. Outside of the surveys, the authors also identified the Tender-skinned Gecko (*G. mutilata*) based on its smooth-looking skin and relatively wider tail base. The presence of the Tokay Gecko (*G. gecko*) was confirmed through its distinct call and visual encounter at the UP Arboretum in 2021.

During the day, diurnal lizards were represented by two native skink species. The endemic Northern Philippine Sun Skink (*E. borealis*) was added to the list, confirmed through visual encounters and specimen examination. Along with the Many-lined Sun Skink (*E. multifasciata*), the two skinks were often encountered while basking.

Lastly, a diversity of snakes inhabits the campus. Three species were recorded during the field survey, while the rest were confirmed from chance visual encounters and photographic evidence. Both the Brahminy Blind Snake (*I. braminus*) and the Gervais' Worm Snake (*C. gervaisii*) were seen under flowerpots or plant debris on the ground. They were found at vegetated sites near UP Lagoon and at the Binhi Arboretum. The blind snake, as well as the Oriental Wolf Snake (*L. capucinus*), are non-endemic species that are common in urban areas (Wogan and Chan-Ard, 2012; Leviton et al. 2018). On the other hand, the campus is also home to two endemic snakes, the Philippine Rat Snake (*C. erythrurus*) and the Northern Triangle-spotted Snake (*C. lineatus*). The former was seen near buildings and houses (e.g., Area 2, Institute of

Biology), while the latter was seen at the layered open forest site beside the Marine Science Institute (MSI). All snakes recorded on campus were either non-venomous or mildly venomous.

A few reptiles were not recorded again since the 1998 inventory. The Philippine Cobra (*Naja philippinensis*) and the Northern Water Snake (*Rhabdophis spilogaster*) were neither encountered nor reported within the last decade. For lizards, the Stejneger's Leaf-toed Gecko (*Hemidactylus stejnegeri*) and skinks under the genus *Sphenomorphus* were similarly absent. Geckos are difficult to distinguish without close examination of features. More species are possibly found on campus that have yet to be included in this list.

Mammals

The mammalian community of the campus is composed of eight volant and three non-volant small mammal species. Of which, three fruit bat species and one invasive non-volant mammal species were captured during the field survey. Nevertheless, all previously known mammal species were recorded again in recent literature except for the invasive Norwegian Rat (*Rattus norvegicus*).

All bats recorded on campus were native species. Among the fruit bat family (Pteropodidae), only the Greater Musky Bat (*P. jagori*) is endemic to the country. This species and the Lesser Short-nosed Fruit Bat (*C. brachyotis*) are the two most captured bats on campus. They were recorded in various habitats and even in areas of high human disturbance for as long as there were fruits and figs available. Both species have also been seen roosting in old buildings and trees. The other frugivorous and/or nectarivorous bats, however, were captured less frequently. The Cave Nectar Bat (*E. spelaea*) and Geoffroy's Rousettes (*R. amplexicaudatus*) are cave-dwelling species (Waldien et al. 2019; Waldien et al. 2020). Between the two, the *R. amplexicaudatus* was rarer and last recorded in 2017 during a class exercise in ecology at the Binhi Arboretum. Given the absence of caves on campus, the encountered individuals were likely passing by or foraging on campus. The Long-tongued Fruit Bat (*M. minimus*) was caught a handful of times at the Binhi Arboretum during a student thesis study (Abdao 2019). The presence of fruiting trees on the campus explains the presence of these bat species. Maintaining and improving plant diversity can further promote urban bat diversity (Threlfall et al. 2016).

The four insect bat species are likewise native and represent two families (Emballonuridae and Vespertilionidae). Although the surveys failed to capture any of the insect bats, the authors have captured the Java Pipistrelle (*P. javanicus*), the Lesser Asiatic Yellow Bat (S. *kuhlii*), and the Black-bearded Tomb Bat (*T. melanopogon*) during ecology and vertebrate biology class exercises (Table 2). A small colony of *T. melanopogon* was also observed to be roosting at an old building, the Romulo Hall.

In contrast, the non-flying mammals in the list were all introduced species. Only the Asian House Rat (*R. tanezumi*) was recorded in the surveys. The presence of the shrew was confirmed from a few dead specimens at the National Science Complex, while the Finlayson's squirrel (*C. finlaysonii*) was caught in a video near the Marine Science Institute by the security guard. The squirrel is native to Thailand, Cambodia, Laos, and Vietnam but was introduced to other countries, including the Philippines, through the pet trade (Bertolino 2009). Due to their high adaptability to urban habitats, these squirrels are considered 'high-risk' species and have the potential to become invasive once populations have been established (Bertolino and Lurz 2013).

Species-habitat Association

The 16 species encountered during the survey period were found across five different habitat types, namely built areas, grasslands, grassy open forests, layered open forests, and open urban forests (Table 3).

Table 3. Abundance of non-avian vertebrate species encountered during survey efforts within UP Diliman across different habitat types

Species	Habitat Types				
	Built area	**Grassland**	**Grassy Open Forest**	**Layered Open Forest**	**Open Urban Forest**
Amphibians					
E. planirostris	4	0	47	21	1
H. rugulosus	1	0	0	0	1
H. erythraea	0	1	1	3	0
K. pulchra	9	10	7	10	0
O. laevis	0	16	0	0	0
P. leucomystax	14	1	1	13	1
R. marina	22	69	92	108	1
Reptiles					
C. gervaisii	0	0	0	0	1
H. brookii	10	2	7	8	2
H. frenatus	26	7	34	40	7
I. braminus	1	0	0	1	0
L. capucinus	0	0	1	0	0
Mammals					
C. brachyotis	4	15	6	14	11
E. spelaea	*1*	1	0	0	0
P. jagori	*3*	17	1	2	3
R. tanezumi	*2*	0	0	2	1

Overall species richness per grid was analyzed across the different habitat types. Built areas and grassy open forests, on average, show lower species richness compared to the other habitat classifications (Figure 2). However, results revealed no significant differences on the total vertebrate species richness of the grid between habitat types (Kruskal-Wallis test, p-value = 0.9021). This also suggested that all habitat types are equally important in supporting urban vertebrate diversity.

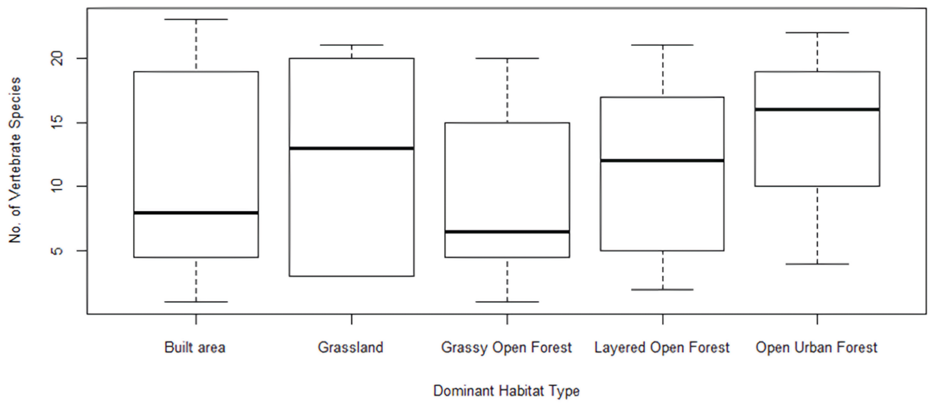

Figure 2. Comparison of species richness among amphibians, reptiles, and mammals encountered during the August 2019 – February 2020 survey efforts per grid across the five habitat classifications of the UP Diliman study site.

Species richness was also examined against grid characteristics, canopy area, and building area. The number of species per grid was not influenced by canopy cover (Kruskal-Wallis test; p-value = 0.88). Examining species richness against building area, however, revealed a positive association (GLM; p-value<0.0001). Upon further analysis at the taxonomic class level, only the reptilian species richness was affected by building area (GLM; p-value= 0.0033). This may be attributed to the high abundance of *H. frenatus* around buildings (Ota and Whittaker 2010). Both amphibian and mammalian species richness showed non-significant relationship with building area (p-value = 0.1 and p-value = 0.44, respectively).

This lack of a significant correlation between habitat type and species richness may be explained by several factors. The assemblage of species found within the campus, particularly the non-native and invasive species, may be generalists which occupy a high diversity of habitats and are less sensitive to habitat disturbance than species restricted to a smaller number of habitats (Segura et al. 2007). It is also possible other factors have a greater effect on species richness within the campus.

A study by Vallejo et al. from 2008 for example, has found that bird abundance is more affected by the number of spatial entities (i.e., the number of buildings and trees) as compared to spatial area (i.e., building area and canopy cover), which was used in this study. A similar pattern may be observed in the abundance of other non-avian vertebrate taxa.

CONCLUSIONS

With globally increasing urbanization rates, green urban spaces are important centers of biodiversity that are increasingly becoming threatened. The UP campus has undergone and is continuing to undergo a transformation in the form of further urban development projects. This has consequently impacted the different species residing within the campus. A frog under the *Fejervarya* genus, the endemic snakes *Naja philippinensis*, and *Rhabdophis spilogaster,* as well as the gecko *Hemidactylus stejnegeri* and skinks under the *Sphenomorphus* genus, are all previously recorded species that were not observed in this study.

Change is part and parcel of infrastructural development but should not come at the cost of valuable wildlife resources. Light pollution from bright streetlights (Holker et al. 2010), the cementation of grassy patches (Klaus 2013), and the construction of ripraps around streams (Bernhardt and Palmer 2007) are a few examples of construction projects that can negatively impact the wildlife present in the area. Moving forward, the preservation of this wildlife resource should be a constant consideration. Care must be taken to ensure that the resulting space is beneficial to the residents of the area, humans and wildlife alike.

In order to attain a future wherein wildlife thrives alongside urban development, it is imperative that the continued monitoring of our wildlife resources and how they change over time is maintained. In future studies, it is also recommended to examine seasonality, an aspect that was excluded from this study as a result of Covid-19 restrictions, which may reveal a different set of observable species. Lastly, it is also recommended to examine spatial entities, in addition to spatial area and habitat types, when determining species habitat associations.

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