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WINGING IT THROUGH UNPRECEDENTED TIMES: A STUDY OF AVIAN
ADMISSIONS TO WILDLIFE REHABILITATION CENTERS IN THE EASTERN
UNITED STATES AMIDST THE COVID-19 PANDEMIC

by

Thea Tengstrom

A Thesis Submitted in Partial Fulfillment
of the Requirements for a Degree with Honors
(Wildlife Ecology)

The Honors College

University of Maine

May 2024

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ABSTRACT

The onset of the COVID-19 pandemic in 2020 has brought new research that examines the many ways in which humans impact wildlife. Wildlife rehabilitation is a tool that attempts to mitigate some negative effects of anthropogenic activity (domestic cats, window strikes), through specialized care to aid injured and orphaned animals. This study sought to investigate if the ‘Anthropause’, which saw a massive change in human behavior, demonstrated an influence on wild bird admissions to wildlife rehabilitation centers. Twelve centers were selected including both urban and non-urban centers throughout the eastern United States. Bird admission data between 2018 and 2021 were used to examine differences associated with the pandemic in the number, cause, and care of admissions. The findings revealed no widespread changes in admissions to wildlife rehabilitation centers linked to the pandemic but highlighted variable responses between centers and differences among urban and non-urban centers. The wealth of information available through wildlife rehabilitation poses opportunities for long-term monitoring of urban-associated species and impacts of metropolitan activity on wildlife that should be further studied.

ACKNOWLEDGEMENTS

This project has been made possible by wildlife rehabilitation centers and data contributed to the WILD-ONe database (Wildlife Center of Virginia, Waynesboro, Virginia, USA; www.WILD-ONe.org). I would like to thank my advisor, Amber Roth, for all the guidance she has given me throughout my time at the University of Maine. Thanks to my committee members for their input on this project, and my wonderful professors who have provided insight. I would also like to thank my friends and family for their unwavering love and support.

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LIST OF DEFINITIONS

Synanthrope

An undomesticated organism and especially an animal (such as a mouse, pigeon, or raccoon) that lives in close association with people and benefits from their surroundings and activities. (Merriam-Webster, 1998)

Degrees of synanthropy (Johnston, 2001)

“A full synanthrope is a species in which most populations have major dependence on variables influenced by humans; this usually involves food, structural habitat, or dispersal. A casual synanthrope is a species in which populations exploit human ecology without being dependent. A tangential synanthrope is a species in which individuals occasionally exploit human ecology.”

INTRODUCTION

Wildlife rehabilitation helps to mitigate some of the negative anthropogenic impacts faced by wild species today through specialized care to help injured or orphaned animals recover and return to their natural habitats. Rehabilitation can also serve to grow our knowledge about species and raise public awareness around them and threats they face (Perry & Averka, 2020). Previous work from the University of Maine using data from wild birds admitted to rehabilitation centers in the Northeast and Midwest highlighted the useful role of wildlife rehabilitation in research and the potential applications within conservation (Duffy, 2020). Many of the top threats to birds in the United States, as identified by the U.S. Fish and Wildlife Service, are also common causes of admission to wildlife rehabilitation centers such as collisions with vehicles or buildings and attacks by cats (Loss et al., 2015). Since 1970, scientists estimated a 29% net decline in bird abundance in North America largely due to habitat loss or disturbance and human-caused mortality. (Rosenberg et al., 2019).

With the onset of the COVID-19 pandemic many countries globally implemented quarantine measures to slow the spread of the virus; this phenomenon of decreased human activity and travel has been coined the ‘Anthropause’ (Rutz et al., 2020). Increased transmission of the virus throughout the United States led many state and local officials to issue stay-at-home, or lockdown, orders. These orders sought to slow the spread of the virus by altering human behavior at the population level and were carried out through social distancing such as restrictions of non-essential travel and large group gatherings, and in some cases physical distancing and mask mandates (Friedson et al., 2020). Social distancing orders were issued at the state rather than the federal level which

resulted in variation between areas (Hallas et al., 2021). Urban areas have been documented as exhibiting higher compliance to social distancing measures during the pandemic compared to rural areas (Park et al., 2021). This adherence may connect to larger shifts in behavior within urban areas compared to their rural counterparts.

Factors associated with human development such as urban noise, traffic, and air and light pollution can disturb birds and impact their habitat use (Kowarik, 2011, Senzaki et al., 2020). Due to stay-at-home orders that impacted human behavior throughout the world, many developed areas saw decreases in these disturbing and polluting activities (Berman & Ebisu, 2020). As a result changes in animal behavior patterns were also seen highlighting certain impacts of humans on wildlife (Burton, 2024, Gordo et al., 2021, Soh et al., 2021, Zellmer et al., 2020). Across the country, states saw a decrease in travel to public spaces at the onset of the pandemic (Jacobsen & Jacobsen, 2020). Fewer vehicles on the road from less travel led some wildlife to use these spaces more frequently as movement corridors (Abraham & Mumma, 2021). Similarly reduced human activity and traffic from both cars and planes resulted in areas close to these anthropogenic hubs being used more often by birds (Schrimpf et al., 2021).

The stay-at-home orders issued throughout the United States led many households to adopt new hobbies and seek connection in new ways such as through nature. Wild bird engagement increased with lockdown measures through bird feeding and bird baths (Brock et al., 2021, Doremus et al., 2023). As a result, people likely became more attuned to observation of injured birds and more likely to bring them to rehab centers. Outdoor recreation was often promoted by states for citizen's mental health and well-being, and the use of urban greenspaces increased during and after lockdowns (Grima et al., 2020,

Ugolini et al., 2020). While many people continued or began outdoor recreation during the pandemic, some who previously participated no longer did (Taff et al., 2021). Also backcountry recreation and distance traveled for outdoor recreation decreased with the pandemic (Rice et al., 2020). These changes differed between demographic groups and place of residence, indicating that more ethnically diverse and/or urban residing populations undertook less outdoor recreation (Pipitone & Jović, 2021). This could contribute to decreases in admissions from urban locations as people spent less time outdoors and had less potential contact with injured birds. It may also influence the species compositions of wild birds admitted to rehabilitation centers such as receiving more admissions from urban-associated species.

Many wildlife rehabilitation centers operate as non-profit organizations with some combination of compensated employees and volunteers. On a global scale, the pandemic caused a major economic crisis the likes of which had not been seen since the 2008 housing collapse or the Great Depression (Van Steenburg et al., 2022). Many businesses felt these impacts both financially and through the loss of labor stemming from lockdown and social distancing. For rehabilitation centers, reductions in staffing could mean reduced capacity for patient admissions. Fewer resources could also mean more time needed to properly rehabilitate admissions or more challenges faced when releasing patients. The goal of rehabilitation centers is foremost to help injured wildlife and return it to the wild, however not all cases are the same. Some patients may be brought for a problem with a simple fix, and some will need months of intensive care to return to normal if they ever do. Wildlife rehabbers practice discretion and try to do what is best for the animals while minimizing pain and stress, and in some instances that means

euthanasia. Rehabbers may have had to be more critical in what cases they were best equipped to handle amidst the pandemic with their given resources.

Objectives with Hypotheses and Predictions

The goal of this research was to examine the potential impacts of the COVID-19 pandemic on wild bird admissions to wildlife rehabilitation centers in the eastern United States (specifically in the Northeast, Mid-Atlantic, and Midwest) and how this relates to human threats and conservation concerns for birds.

Objective 1

To understand if the COVID-19 pandemic influenced bird admissions to wildlife rehabilitation centers.

Hypothesis: The number of annual bird admissions per center decreased with the onset of the COVID-19 pandemic in 2020 with ongoing but lessening effects in 2021.

Alternative Hypotheses:

H₁: The number of annual bird admissions per center decreased for centers located in urban counties with the onset of the COVID-19 pandemic in 2020, with lesser effects for centers in non-urban counties.

H₂: The number of annual bird admissions per center decreased for birds rescued from urban counties with the onset of the COVID-19 pandemic in 2020, with lesser effects for admissions from suburban and rural counties.

H₃: The number of annual bird admissions per center showed region-specific decreases (e.g. more decreases in the Northeast) with the onset of the COVID-19 pandemic in 2020.

H₄: The number of annual bird admissions per center showed taxonomic-specific decreases (e.g. Scolopacidae) or increases (e.g. Cardinalidae) with the onset of the COVID-19 pandemic in 2020.

Lockdown measures may have resulted in both less willingness to take birds to rehabilitation centers and centers not being able to accept as many birds. Since restrictions varied by state, regional variation may be seen in response to the pandemic. Changes in human and bird behavior may have resulted in changes of species composition and abundance within admissions.

Objective 2

To understand if the COVID-19 pandemic influenced causes, duration of care, and outcomes of bird admissions to wildlife rehabilitation centers.

Alternative Hypotheses:

H₁: The number of bird admissions due to vehicle collisions decreased with the onset of the COVID-19 pandemic in 2020.

H₂: Bird care time, excluding bird admissions with less than one day, decreased with the onset of the COVID-19 pandemic in 2020.

H₃: The proportion of bird admissions euthanized upon arrival at the rehabilitation centers increased with the onset of the COVID-19 pandemic in 2020.

The pandemic may have prompted changes in the reasons birds were brought to rehabilitation centers and the care they received. Less travel on roads could result in fewer birds brought due to vehicle-collisions. Fewer resources within rehabilitation centers may have potentially meant shorter care time and more euthanization on admission due to limited capacity to care for certain cases.

Objective 3

To understand if the COVID-19 pandemic influenced admissions of birds associated with bird feeders to wildlife rehabilitation centers.

Hypothesis: The number of ‘feeder’ bird admissions increased with the onset of the COVID-19 pandemic in 2020.

Where outside interactions were often limited to people’s place of residence, increased activity outdoors may have led some to be more attuned to injured birds near them. Engagement with the birds around people’s homes and more potential interactions through supplemental feeding may have increased admissions of these bird feeder associated species.

METHODS

Study Period and Area of Interest

In order to contrast wild bird admissions to rehabilitation centers before and during the COVID-19 pandemic, two years before and during the pandemic were desired. The human response to the spread of the pandemic was most prominent during 2020 in the United States and this was set as the first ‘pandemic’ year of the study. 2021 was regarded as the start of a return to ‘normal’ where anticipated impacts from 2020 may be seen but with less severity. For the purposes of this study the time periods of interest were defined as:

Pre-pandemic ~ January 1st, 2018 to December 31st, 2019

Pandemic ~ January 1st, 2020 to December 31st, 2021

Differences in the number of bird admissions will be examined for the totals among years and monthly admissions among years. March 2020 is when a majority of lockdown measures began throughout the country, so examining admissions at the month level may reveal differences not reflected in the year level.

The area of interest for this study was the United States, but to reduce regional variation in states’ responses to COVID-19 and maintaining continuity in the species pool, a subset of the country was used. Data from this project were in part supported by previous work from the University of Maine which focused on rehabilitation centers in the Northeast and Midwest (Duffy, 2020). This focus was continued in this study, with the Mid-Atlantic region added to create a larger sample size while maintaining geographic proximity.

Data Collection

Two rehabilitation centers were contacted and asked to contribute records of patient admissions. Data for ten centers were sourced from the WILD-ONe database managed by The Wildlife Center of Virginia (Wildlife Center of Virginia, 2024). Centers selected from WILD-ONe were chosen using the following criteria: 1) they operate within the Mid-Atlantic, Midwest, or Northeast region of the United States (U.S. Bureau of Labor Statistics, 2014) 2) they had admissions reported for each year of the study period 3) admissions were composed of at least 50 cases per year within the study period. For this study, details about individual centers were not included to maintain their anonymity.

Data Management

The ten centers sourced from WILD-ONe provided 82,995 gross records of admission across the study period. Within the WILD-ONe dataset, individual admissions sometimes included multiple entries to provide detail on complex causes of admission but were linked by a unique case identifier number. For the purposes of this project only one row of information was needed for each admission, and subsequent ‘duplicate’ rows were removed resulting in 55,872 net admission records across the study period. The two centers outside of the WILD-ONe database contributed 34,265 records, each representing a single admission, across the study period. Records of domestic species were removed from the dataset to maintain focus on wild species. The American Ornithological Society’s Check-list of North and Middle American Birds was used to identify Family, Order, and species based on common names, and any species not listed were removed (Chesser, 2023).

Rescue jurisdiction was the county in which the bird was found initially; the county for each admission was either identified in the database or determined based on the rescue location information provided. Each county of admission was given a rural-urban continuum code, as well as its geographic area (mi²), population, and population density (Table A1, Table A2). In some cases, the rescue location was associated with multiple counties; for these records a RUCC was only listed if both counties had the same value. Population and size were averaged for these cases of multiple-associated counties, but population density was calculated by dividing the sum of county populations by the sum of geographic areas.

Each county from which a bird was rescued was classified as rural, urban, or suburban using the RUCC codes and population densities. Urban and rural metrics of population density defined by the USDA economic research service were referenced to create these classifications (USDA ERS, 2017). Jurisdictions composed of a population density greater than 1000 people per square mile with a 'metro' RUCC classification were designated as 'urban'. Jurisdictions composed of a population density less than 500 people per square mile with a 'non-metro' RUCC classification were designated as 'rural'. Counties with 500-1000 people/square mile, <500 people/sq mi and metro RUCC, or >500 people/sq mi and non-metro RUCC were classified as 'suburban'. Rehabilitation centers were classified as urban or non-urban using the county in which they are located and these classifications. Non-urban centers included both suburban and rural centers; these were combined given there was only one rural center.

Duration of care was calculated by subtracting the date admitted from the date dispositioned. Any records found to have a negative duration of care (0.09%) were

modified to correct this value which arose from having an admission date that came after the disposition date. To minimize imposed bias on the dataset, the admission and disposition dates were transposed for these records as they were assumed to be a data error stemming from someone accidentally reversing these during data entry. Centers sourced from the Wild-one database contained ‘circumstances of rescue’ that provided varying levels of detail for most admissions including the presumed cause or event that resulted in the bird being brought in (i.e., domestic animal interaction, collision with stationary object). Cases identified as having ‘collision with a vehicle’ as the circumstances of rescue were used to investigate objective three. Species were identified as common bird-feeder birds in the Northeast region of North America based on association with any food or feeder type (Project FeederWatch), and all other species were considered non-bird-feeder birds. Species with less than 200 admissions across the four-year study were not included in further analysis related to this classification. This resulted in 31 feeder species (Table A3).

Statistical Analysis

Analyses were conducted using R-studio (Version: 2023.12.1+402), with the packages tidyverse, ggpubr, and rstatix. An alpha of 0.05 was used to determine significance of tests. The Shapiro-Wilk test was used to check for normality of the data used for each objective. Tests that failed the normality assumptions were log transformed. One-way repeated measures ANOVAs were used on normally distributed datasets and included year as the independent variable with four groups representing each year of the study. For significant ANOVA results, a pairwise t-test was used to examine differences between groups. For nonparametric datasets, a Friedman test was used. When datasets

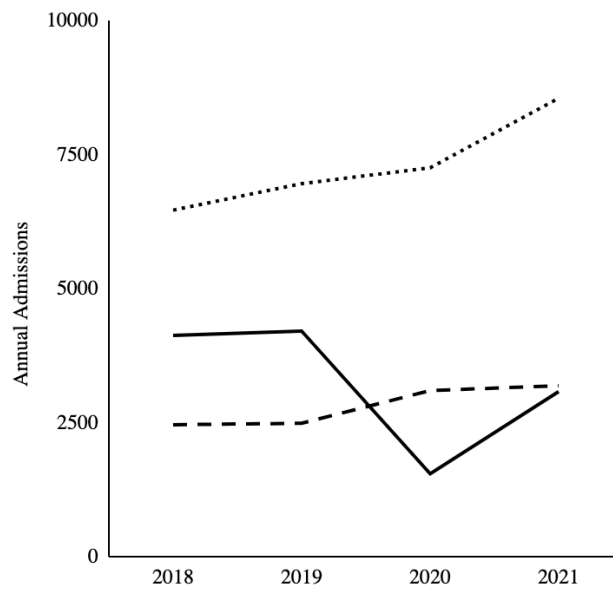
only included two groups for the independent variable (i.e. urban vs. non-urban), a paired t-test was used. Regression analysis in excel was used to examine the relationship between population density and number of wild bird admissions. An intercept of zero was used since a population greater than zero is needed to admit birds to rehabilitation centers.

RESULTS

The compiled wildlife rehabilitation database consisted of 88,684 admissions over four years from 12 centers across seven states. Five rehabilitation centers were classified as urban and seven were classified as non-urban. Rescue jurisdictions included 484 counties across 27 states. Of these counties, 77 were classified as urban, 191 as suburban and 216 as rural. Admissions included 306 species, 59 families, and 22 orders of birds. Annual admissions varied by center from an average of 250 admission per year to upwards of 7,000 admissions per year (Figure 1).

The eight most frequently admitted orders remained consistent in their rank throughout all four years and comprised more than 95% of all admissions (Table 1). The most frequently admitted order of birds was the Passeriformes with 44,233 total cases representing 48-51% of order admissions in each year and was double the next most frequently admitted order, Columbiformes. The most frequently admitted family of birds was the Columbidae (the only representative of Order Columbiformes) with 20,695 total cases representing 21-24% of family admissions in each year; admitted species included Mourning Dove (*Zenaida macroura*), Ring-necked Dove (*Streptopelia risoria*), Rock Pigeon (*Columba livia*). Rock Pigeon also was the most frequently admitted species with 16,384 total cases representing 17-19% of admissions among species in each year. Mourning Doves were also in the top 5 most frequently admitted species with 4,263 total cases (4-5%). Outside of Columbidae, the three most frequently admitted species were the House Sparrow (*Passer domesticus*), American Robin (*Turdus migratorius*) and the Mallard (*Anas platyrhynchos*), contributing 6,368 (7%), 5,935 (6-7%) and 4,752 (4-5%) total cases respectively.

(A)



(B)

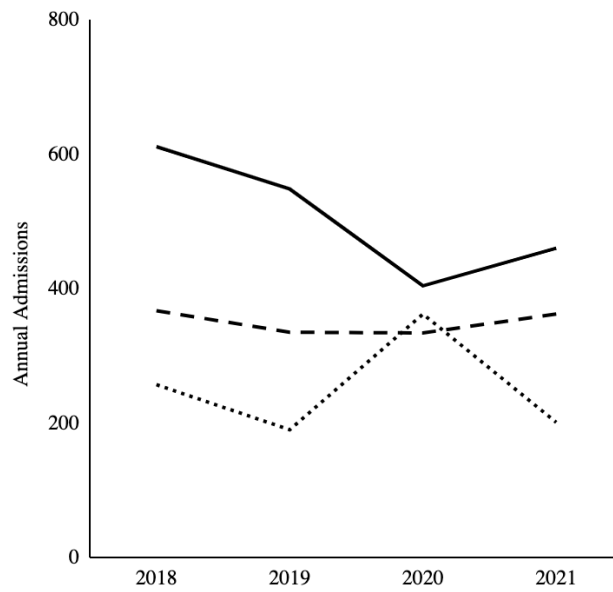


Figure 1. Annual wild bird admissions to three centers with the most admissions (A) and three centers with the fewest admissions (B).

Total					
Order	Admissions	Proportion of Total Admissions	Family	Admissions	Proportion of Total Admissions
Passeriformes	44233	49.9%	Columbidae	20695	23.3%
Columbiformes	20695	23.3%	Anatidae	8642	9.7%
Anseriformes	8642	9.7%	Turdidae	7463	8.4%
Accipitriformes	3450	3.9%	Passeridae	6368	7.2%
Charadriiformes	2517	2.8%	Parulidae	5612	6.3%
Strigiformes	2395	2.7%	Passerellidae	4435	5.0%
Piciformes	2025	2.3%	Sturnidae	3548	4.0%
Apodiformes	1353	1.5%	Accipitridae	3362	3.8%
Falconiformes	582	0.7%	Fringillidae	3046	3.4%
Cathartiformes	500	0.6%	Corvidae	2397	2.7%
2018					
Order	Admissions	Proportion of Total Admissions	Family	Admissions	Proportion of Total Admissions
Passeriformes	10964	50.8%	Columbidae	4700	21.8%
Columbiformes	4700	21.8%	Anatidae	2020	9.4%
Anseriformes	2020	9.4%	Turdidae	1786	8.3%
Accipitriformes	938	4.3%	Passeridae	1599	7.4%
Charadriiformes	616	2.9%	Parulidae	1578	7.3%
Strigiformes	593	2.7%	Passerellidae	1042	4.8%
Piciformes	484	2.2%	Accipitridae	916	4.2%
Apodiformes	339	1.6%	Sturnidae	869	4.0%
Falconiformes	168	0.8%	Fringillidae	733	3.4%
NA	151	0.7%	Corvidae	643	3.0%
2019					
Order	Admissions	Proportion of Total Admissions	Family	Admissions	Proportion of Total Admissions
Passeriformes	11214	51.1%	Columbidae	5113	23.3%
Columbiformes	5113	23.3%	Turdidae	1913	8.7%
Anseriformes	1910	8.7%	Anatidae	1910	8.7%
Accipitriformes	765	3.5%	Passeridae	1592	7.3%
Charadriiformes	735	3.3%	Parulidae	1542	7.0%
Strigiformes	618	2.8%	Passerellidae	1448	6.6%
Piciformes	461	2.1%	Sturnidae	875	4.0%
Apodiformes	367	1.7%	Accipitridae	738	3.4%
Falconiformes	130	0.6%	Strigidae	599	2.7%
Galliformes	106	0.5%	Fringillidae	586	2.7%

Table 1. The ten most frequently admitted orders, families, and species of wild birds to the 12 wildlife rehabilitation centers in the Northeast, Mid-Atlantic, and Midwest from 2018 to 2021.

2020						
Order	Admissions	Proportion of Total Admissions	Family	Admissions	Proportion of Total Admissions	Species
Passeriformes	10139	48.3%	Columbidae	4952	23.6%	Rock Pigeon
Columbiformes	4952	23.6%	Anatidae	2286	10.9%	American Robin
Anseriformes	2286	10.9%	Turdidae	1847	8.8%	House Sparrow
Accipitriformes	814	3.9%	Passeridae	1433	6.8%	Mallard
Strigiformes	587	2.8%	Parulidae	977	4.7%	Mourning Dove
Charadriiformes	542	2.6%	Passerellidae	892	4.2%	European Starling
Piciformes	536	2.6%	Sturnidae	811	3.9%	Canada Goose
Apodiformes	301	1.4%	Accipitridae	792	3.8%	House Finch
Galliformes	149	0.7%	Fringillidae	705	3.4%	Wood Duck
Falconiformes	143	0.7%	Corvidae	577	2.7%	Blue Jay
2021						
Order	Admissions	Proportion of Total Admissions	Family	Admissions	Proportion of Total Admissions	Species
Passeriformes	11916	49.3%	Columbidae	5930	24.5%	Rock Pigeon
Columbiformes	5930	24.5%	Anatidae	2426	10.0%	House Sparrow
Anseriformes	2426	10.0%	Turdidae	1917	7.9%	American Robin
Accipitriformes	933	3.9%	Passeridae	1744	7.2%	Mallard
Charadriiformes	624	2.6%	Parulidae	1515	6.3%	Mourning Dove
Strigiformes	597	2.5%	Passerellidae	1053	4.4%	European Starling
Piciformes	544	2.3%	Fringillidae	1022	4.2%	House Finch
Apodiformes	346	1.4%	Sturnidae	993	4.1%	Canada Goose
Pelecaniformes	154	0.6%	Accipitridae	916	3.8%	White-throated Sparrow
Cathartiformes	149	0.6%	Corvidae	732	3.0%	Blue Jay

Comparison of Time Periods

Admissions averaged 1,848 cases per year with 2021 having the highest average of 2,013 cases per center (SD = 2,270), followed by 2019 with 1,830 (SD = 1,950), 2018 with 1,799 (SD = 1,809), and 2020 with 1,749 (SD = 1,894) (Table 2.) These total annual admissions for each center were similar across the study period ($P = 0.64$) (Figure 2). Monthly admissions also followed a similar pattern among years, with a peak of admissions around May or June and a second smaller peak in September or October (Figure 3). Three months differed between years, those being January ($F_{2,19} = 4.13$, $P = 0.04$), February ($F_{3,33} = 4.38$, $P = 0.03$), and December ($F_{3,33} = 4.95$, $P < 0.01$) (Figure A1). January 2021 received more admission than January 2019 ($F_{11} = -3.47$, $P = 0.03$) and January 2020 ($F_{11} = -4.44$, $P < 0.01$). February 2021 also received more admissions than February 2019 ($F_{11} = -4.89$, $P < 0.01$), and December 2020 received more admissions than December 2018 ($F_{11} = -3.65$, $P = 0.02$).

Year	Total Admissions	Minimum	Maximum	Mean	SD	SE
2018	21583	257	6463	1799	1809	522
2019	21955	190	6958	1830	1950	563
2020	20989	334	7253	1749	1894	547
2021	24157	201	8550	2013	2270	655

Table 2. Total, minimum, maximum, and mean wild bird admissions to the 12 wildlife rehabilitation centers in the Northeast, Mid-Atlantic, and Midwest from 2018 to 2021.

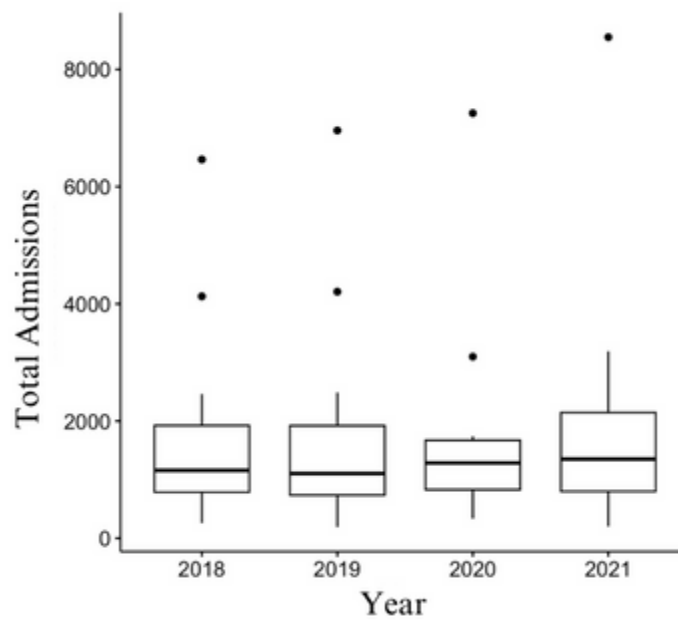


Figure 2. Annual wild bird admissions to the 12 wildlife rehabilitation centers.

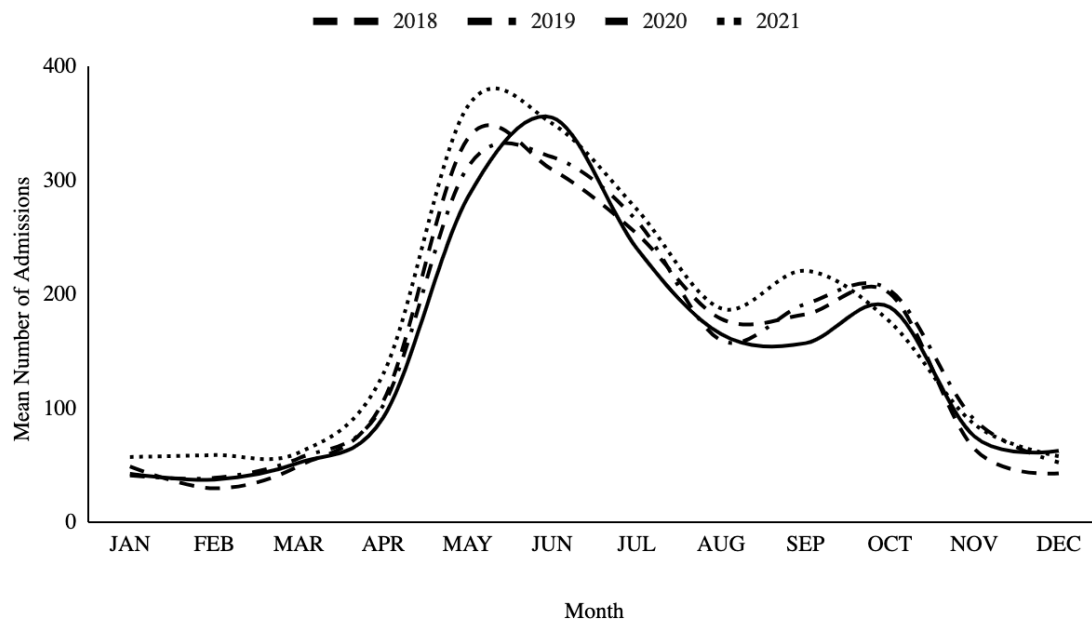


Figure 3. Mean monthly admissions of wild birds to the 12 wildlife rehabilitation centers from 2018 to 2021.

Comparison of Admissions by Location of Center, Rescue Sources, and Region

Five centers included in the study were classified as urban, with the other seven being non-urban. Urban centers received more admissions on average compared to non-urban centers ($t_8 = -3.05$ to -2.46 , $P = 0.01$ to 0.03), and this pattern was consistent through time (Figure 4). A relationship between the number of admissions and population density exists ($R^2 = 0.61$, $F_{1,421} = 670$, $p < 0.01$), demonstrating that increased population density predicted increased admissions ($\beta = 0.47$ with $0.43 - 0.51$ 95% CI; Figure 5). Neither urban nor non-urban centers showed differences in total admissions among years ($P = 0.67$ to 0.94). Admissions from urban areas comprised 59.6% of all admissions, followed by suburban admissions with 34.1%, and rural admissions with 6.3% (Table 3). Birds rescued from urban, suburban, and rural areas had similar admissions among years ($P = 0.11 - 0.54$) (Figure A2).

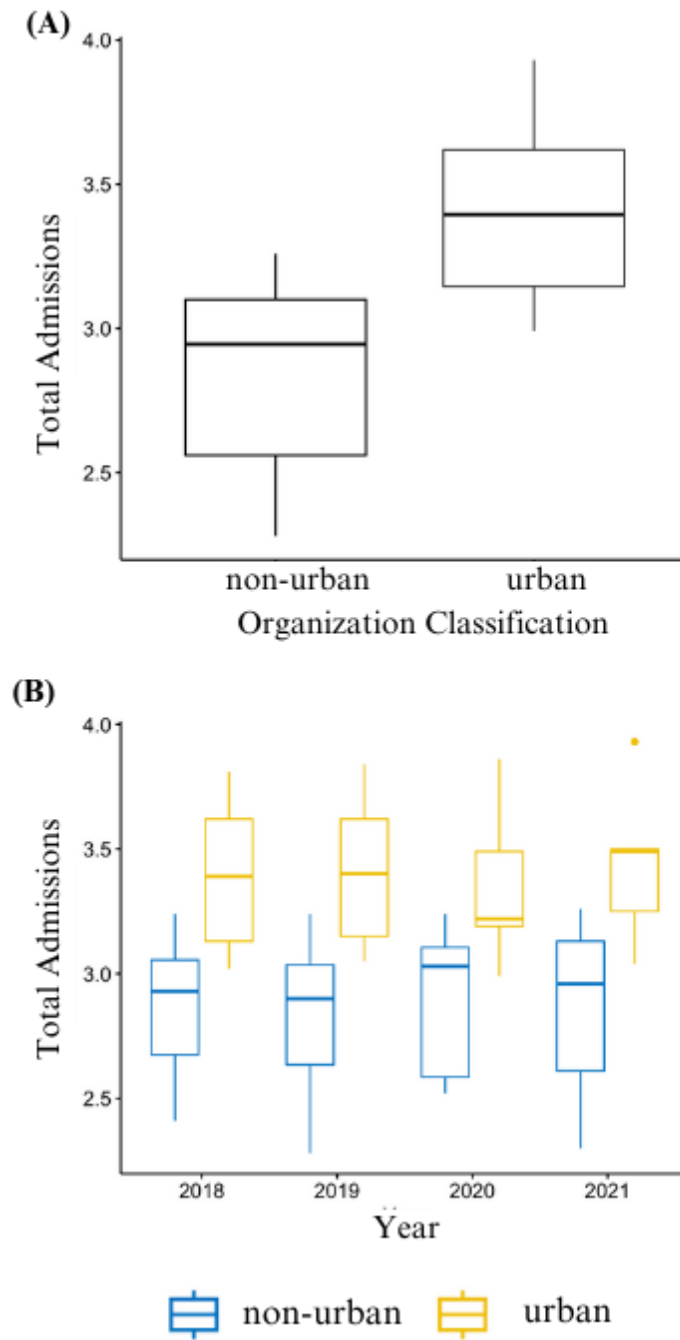


Figure 4. Log transformed wild bird admissions to urban and non-urban centers summed across the study periods (A) and from 2018 to 2021 (B).

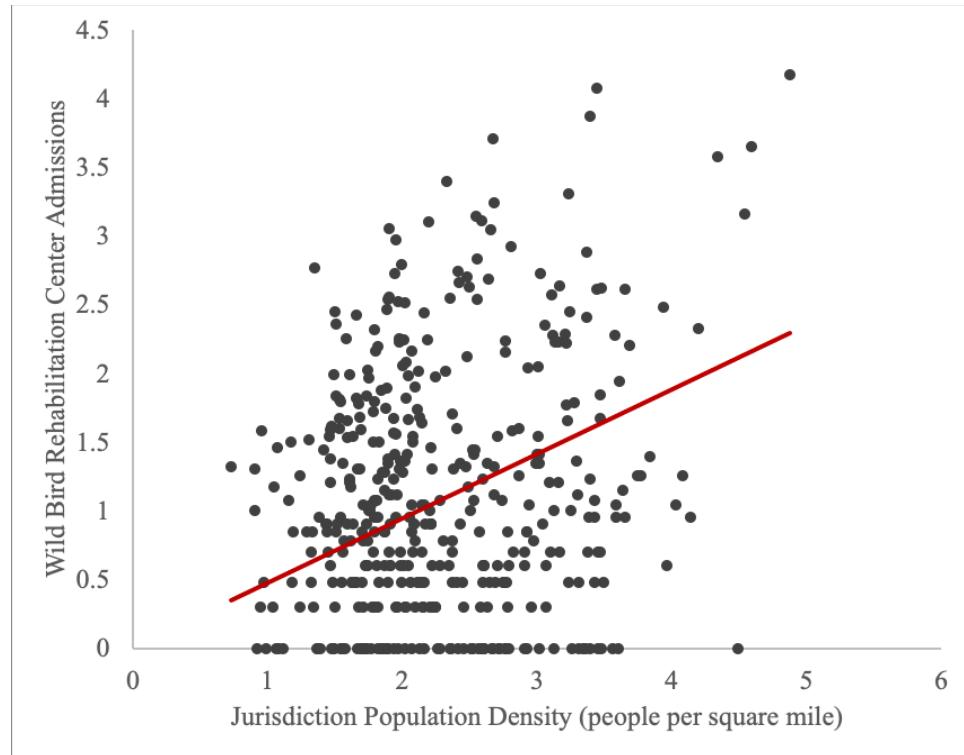


Figure 5. Regression of log transformed wild bird admission to rehabilitation centers and log transformed population densities.

Year	Organization Classification	Urban	Urban Proportion	Suburban	Suburban Proportion	Rural	Rural Proportion	Total
2018	Non-Urban	531	8.7%	4499	73.6%	1081	17.7%	6111
	Urban	10574	68.3%	4649	30.0%	249	1.6%	15472
	Total	11105	51.5%	9148	42.4%	1330	6.2%	21583
2019	Non-Urban	472	8.2%	4246	73.5%	1058	18.3%	5776
	Urban	13757	85.0%	2167	13.4%	255	1.6%	16179
	Total	14229	64.8%	6413	29.2%	1313	6.0%	21955
2020	Non-Urban	618	9.5%	4627	71.5%	1228	19.0%	6473
	Urban	11688	80.5%	2519	17.4%	309	2.1%	14516
	Total	12306	58.6%	7146	34.0%	1537	7.3%	20989
2021	Non-Urban	573	8.9%	4822	74.5%	1079	16.7%	6474
	Urban	14607	82.6%	2751	15.6%	325	1.8%	17683
	Total	15180	62.8%	7573	31.3%	1404	5.8%	24157
2018 - 2021	Non-Urban	2194	8.8%	18194	73.3%	4446	17.9%	24834
	Urban	50626	79.3%	12086	18.9%	1138	1.8%	63850
	Total	52820	59.6%	30280	34.1%	5584	6.3%	88684

Table 3. Total wild bird admissions from urban, suburban, and rural areas to 12 urban, suburban, and rural wildlife rehabilitation centers in the Northeast, Mid-Atlantic, and Midwest from 2018 to 2021.

Birds rescued from urban areas showed higher admissions to urban centers than to non-urban centers ($t_s = 4.21$ to 5.00 , $P < 0.01$), and this pattern was consistent among years (Figure 6A). Urban admissions represented 79.3% of birds taken to urban rehabilitation centers, and 8.8% for non-urban centers. Birds rescued from suburban areas had similar admissions to non-urban and urban centers ($P = 0.55$ to 0.88) (Figure 6B), with these admissions making up 18.9% cases for urban centers and 73.3% for non-urban centers. Birds rescued from rural areas had similar admissions to urban and non-urban centers ($P = 0.19$ to 0.29), with these admissions making up 1.8% cases for urban centers and 17.9% for non-urban centers (Figure 6C).

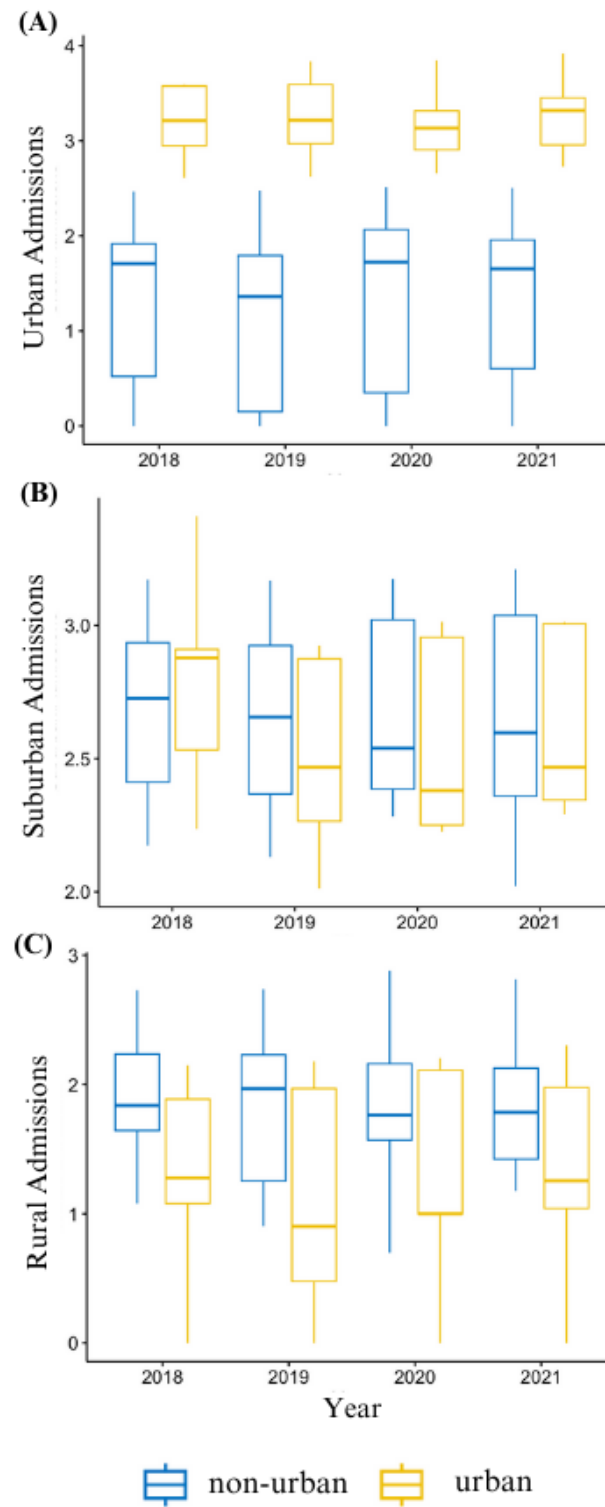


Figure 6. Log transformed annual admissions from urban (A), suburban (B), and rural (C) jurisdictions to urban and non-urban centers.

Six rehabilitation centers were located in the Midwest region, three in the Northeast, and three in Mid-Atlantic. Total annual admissions by center were similar between the Mid-Atlantic, Midwest, and Northeast ($P = 0.26$ to 0.85) and among years ($P = 0.82$ to 1.00) (Figure A3).

Comparison of Taxonomic Groups

One bird order (of 22) and two families (of 59) differed in admissions among years. Podicipediformes, the order of grebes, received more admissions in 2018 than 2019, 2020, or 2021 ($F_{11} = 3.24$ to 4.14 , $P = 0.01$ to 0.05) (Figure 7A). Fringillidae, the family of finches, received more admissions in 2021 than in 2019 or 2020 ($F_{11} = 3.75$ to 4.00 , $P = 0.01$ to 0.02) (Figure 7B). Sittidae, the family of nuthatches, received fewer admissions in 2019 than in 2020 ($F_{11} = -3.19$, $P = 0.05$) (Figure 7C).

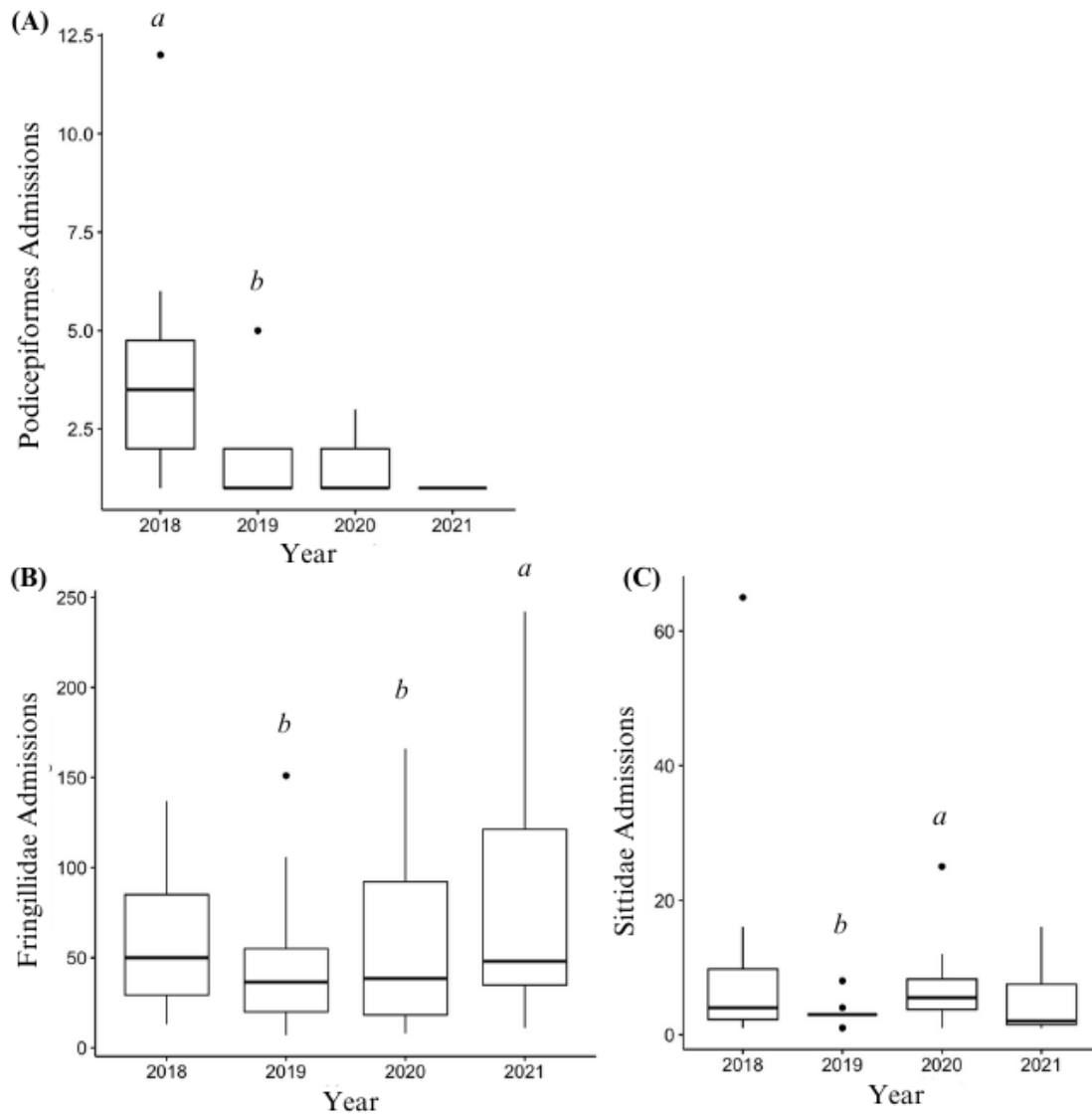


Figure 7. Annual admissions of Podicipediformes (A), Fringillidae (B), and Sittidae (C), (a) years had more admissions than (b) years.

The most frequently admitted bird species for urban centers was the Rock Pigeon and for non-urban centers it was the American Robin (Table 4). Rock Pigeons are considered full synanthropes and are dependent on humans, American Robins are considered casual synanthropes that are not dependent on humans but will exploit human ecology. The twenty-five most frequently admitted species for both urban and non-urban centers includes four full, five casual, and 18 tangential synanthropes. Urban centers received more admissions of three bird orders and 12 families in 29 of 60 years compared to non-urban wildlife rehabilitation centers (Table 5). Only Passeriformes, the order of passerine birds, differed in annual admissions between urban and non-urban centers every year ($t_{11} = 2.82$ to 3.32 , $P = 0.01$ to 0.02) (Figure 8). The high variation of admissions among centers (especially urban), such as for Turdidae, contributed to lack of a significant result in many cases (Figure 9).

Urban	Synanthropy*	Proportion of Admissions	Non-urban	Synanthropy*	Proportion of Admissions
Rock Pigeon	F	25.2%	American Robin	C	10.1%
House Sparrow	F	8.6%	Mallard	T	7.2%
American Robin	C	5.4%	Mourning Dove	T	5.9%
European Starling	F	4.7%	House Finch	C	4.6%
Mallard	T	4.6%	House Sparrow	F	3.5%
Mourning Dove	T	4.4%	Wood Duck	C	3.3%
White-throated Sparrow	T	2.8%	Northern Cardinal	T	2.9%
Canada Goose	C	2.5%	Carolina Wren		2.8%
American Woodcock		1.6%	Red-tailed Hawk	T	2.7%
Blue Jay	T	1.6%	European Starling	F	2.1%
House Finch	C	1.5%	Barred Owl		2.0%
Common Yellowthroat	T	1.4%	Blue Jay	T	2.0%
Red-tailed Hawk	T	1.4%	Common Grackle	T	2.0%
Northern Cardinal	T	1.3%	Canada Goose	C	2.0%
Common Grackle	T	1.0%	American Goldfinch	T	1.8%
Lincoln's Sparrow	T	0.9%	Great Horned Owl	T	1.8%
Ovenbird		0.9%	Eastern Bluebird	T	1.6%
Gray Catbird	T	0.8%	American Crow	T	1.6%
Carolina Wren		0.8%	Chimney Swift	F	1.5%
Magnolia Warbler		0.7%	Cedar Waxwing		1.4%
Golden-crowned Kinglet		0.7%	Eastern Screech-Owl	T	1.4%
Wood Duck	C	0.7%	Barn Swallow	T	1.3%
Eastern Screech-Owl	T	0.7%	Ruby-throated Hummingbird	T	1.3%
Song Sparrow	T	0.7%	Bald Eagle		1.2%
Cooper's Hawk		0.6%	Herring Gull	C	1.2%

Table 4. Top wild bird species admissions, proportion of admissions, and synanthropy (F ~ full, C ~ casual, T ~ tangential, Johnston, 2001) to the 12 urban and non-urban wildlife rehabilitation centers in the Northeast, Mid-Atlantic, and Midwest from 2018 to 20

**Data for Synanopic status from Johnston (2001)*

Order	Family	Total Admissions	df	<i>t</i>	<i>P</i>	2018	2019	2020	2021
Passeriformes	<i>(all families)</i>	44233	9	2.82 - 3.32	0.01 - 0.02	*	*	*	*
Passeriformes	Turdidae	7463	9	2.47 - 2.66	0.03		*		*
Passeriformes	Passeridae	6368	10	2.22 - 2.54	0.03 - 0.05	*	*		*
Passeriformes	Parulidae	5612	6	2.54 - 2.56	0.04		*		*
Passeriformes	Passerellidae	4435	7	2.42	0.05				*
Passeriformes	Sturnidae	3548	10	2.55 - 3.03	0.01 - 0.03	*	*		
Passeriformes	Corvidae	2397	8	2.75 - 3.58	0.01 - 0.03	*	*		
Passeriformes	Mimidae	1232	8	2.41 - 3.19	0.01 - 0.04		*		*
Passeriformes	Regulidae	720	6	2.48	0.05			*	
Pelecaniformes	<i>(all families)</i>	433	8	2.86	0.02			*	
Pelecaniformes	Ardeidae	408	8	4.17	<0.01			**	
Cuculiformes	<i>(all families)</i>	176	9	2.95 - 4.09	<0.01 - 0.01	**	**		*
Gruiformes	Rallidae	153	5	2.54 - 2.83	0.03	*			*
Suliformes	Phalacrocoracidae	141	10	2.39	0.04	*			
Accipitriformes	Pandionidae	88	10	2.68	0.02				*

Table 5. Wild bird orders and families with higher admissions to urban centers (indicated with * or **) than non-urban centers across the 12 wildlife rehabilitation centers in the Northeast, Mid-Atlantic, and Midwest from 2018 to 2021. (* indicates p value < 0.

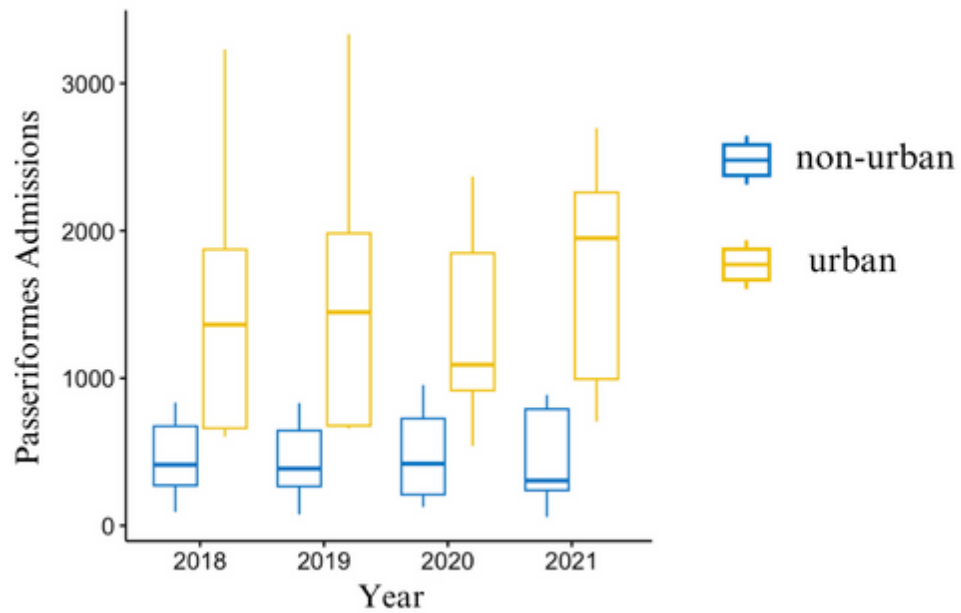


Figure 8. Annual Passeriformes admissions to urban and non-urban wildlife rehabilitation centers.

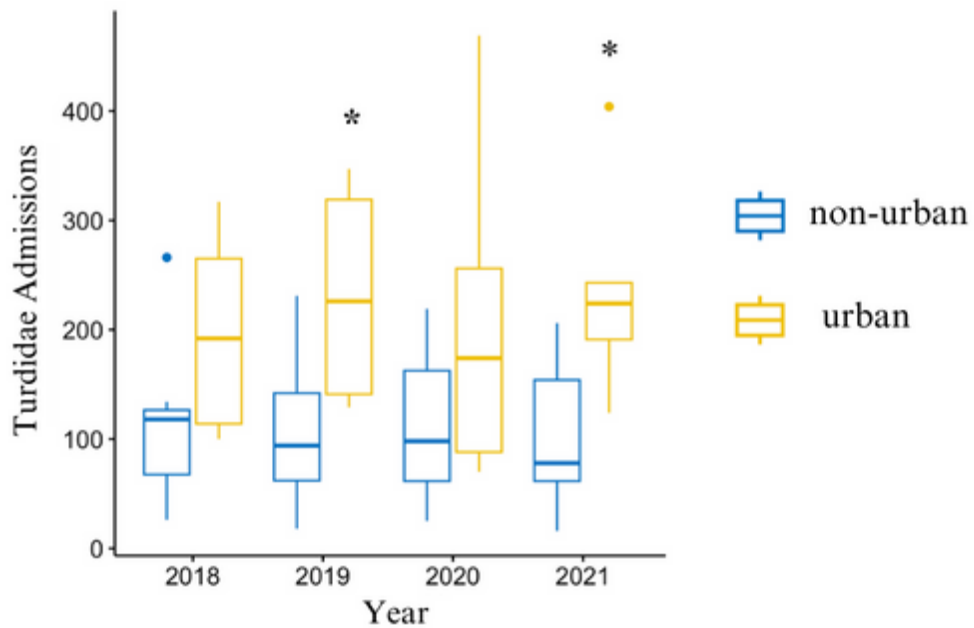


Figure 9. Annual admissions of Turdidae birds to urban and non-urban wildlife rehabilitation centers.

Cause of Admissions, Care, and Outcomes

Bird admissions due to vehicle collisions contributed 4,526 cases (8.1%) to the dataset for an average of 1,132 admissions per year. These admissions showed similarities among years ($P = 0.43$) (Figure A5), and months ($P = 0.06$ to 0.10). June contributed the most vehicle-collision admissions each year.

The total time admitted birds spent in the care of rehabilitation centers within the study period was 1,103,163 days (Table A4). Patients that were released represented 77% of this care time or 850,874 days. The longest time spent by an admitted bird within the study period was in 2020 for one year, four and a half months. The average time birds were under care at a given rehabilitation center was 12.6 days, by removing admissions that did not receive one or more days of treatment, mean care time increased to 22.3 days. Mean care time was similar among years ($P = 0.13$). Non-urban centers spent more mean time per bird caring for patients in 2020 than urban centers ($t_s = 2.97$, $P = 0.02$) (Figure 10).

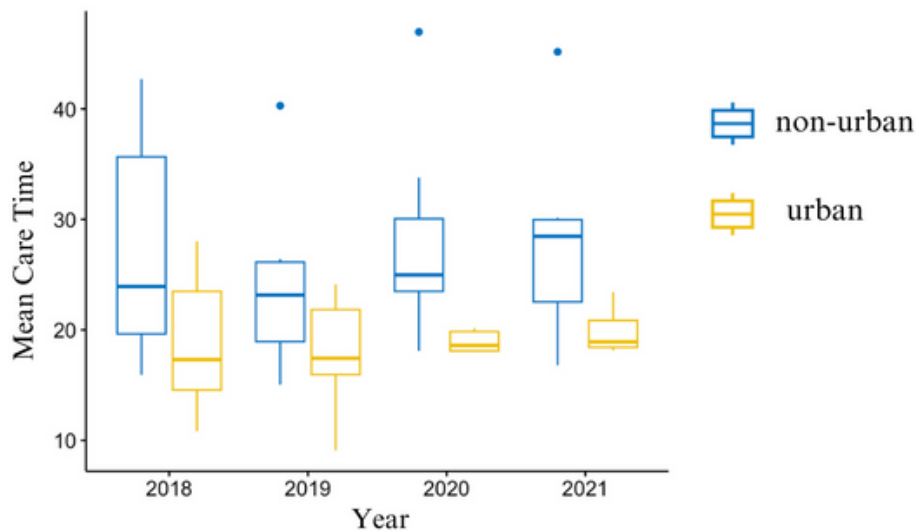


Figure 10. Mean annual care time of birds that received treatment at urban and non-urban wildlife rehabilitation centers.

Three types of outcomes were investigated: euthanized, died, and released. Other outcomes in the data included ‘transferred’, ‘education animal’, and ‘self-release’; these were not investigated due to their small sample sizes but were included in the total calculations. Admission outcomes were similar among years ($P = 0.16 - 0.77$) (Figure A4). This was consistent for both cases that received treatment ($P = 0.18 - 0.61$) as well as those that did not ($P = 0.06 - 0.72$).

Admissions that were euthanized on arrival increased 19% between the pre-pandemic and pandemic time periods, though this difference was not found to be statistically significant ($P = 0.06$). Urban and non-urban centers had similar admissions of birds that received care and died, were euthanized, or were released ($P = 0.06 - 0.36$). Admissions that did not receive care and died were greater for urban centers among years ($t = 2.67 - 2.81$, $P = 0.02 - 0.03$). Birds that did not receive care and were euthanized had greater admissions for urban centers in 2018, 2019, and 2021 ($t = 2.40 - 2.58$, $P = 0.03 - 0.04$). Birds that were released the same day had greater admissions for urban centers in 2018, 2020, and 2021 ($F = 2.35 - 3.98$, $P = 0.01 - 0.05$).

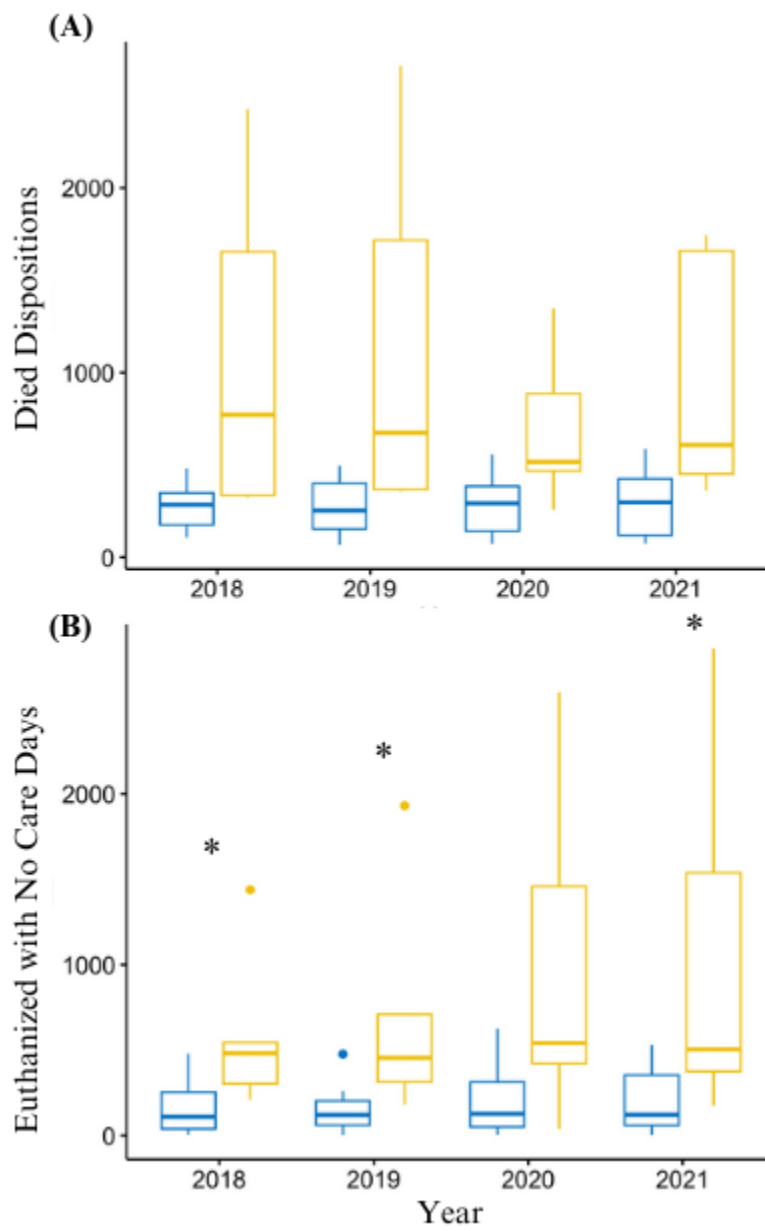


Figure 11. Annual bird admissions that died (A) and were euthanized with no care days (B) at urban and non-urban centers from 2018 to 2021.

Bird-Feeder Species

Thirty bird-feeder associated species were used for the analysis (Table A3). Two groups showed differences among years, American Crows (*Corvus brachyrhynchos*) and House Finches (*Haemorrhous mexicanus*). Admissions of American crows were greater in 2019 than in 2018 ($F_{11} = 4.20$, $P = 0.01$). Admissions of House Finches were greater in 2021 than in 2020 ($F_{11} = 4.13$, $P = 0.01$). All other ‘feeder’ bird species had similar admissions among years ($P = 0.07 - 0.91$).

Admission of feeder birds to urban wildlife rehabilitation centers was greater than to non-urban centers for all years except 2020 ($t_s = 2.64$ to 2.81 , $P = 0.02$ to 0.03) (Figure 12). Urban centers received more admissions of 11 feeder bird species in 19 of 44 years compared to non-urban wildlife rehabilitation centers (Table 6). Urban centers received more Blue Jay (*Cyanocitta cristata*) admissions in all years but 2020 (Figure 13).

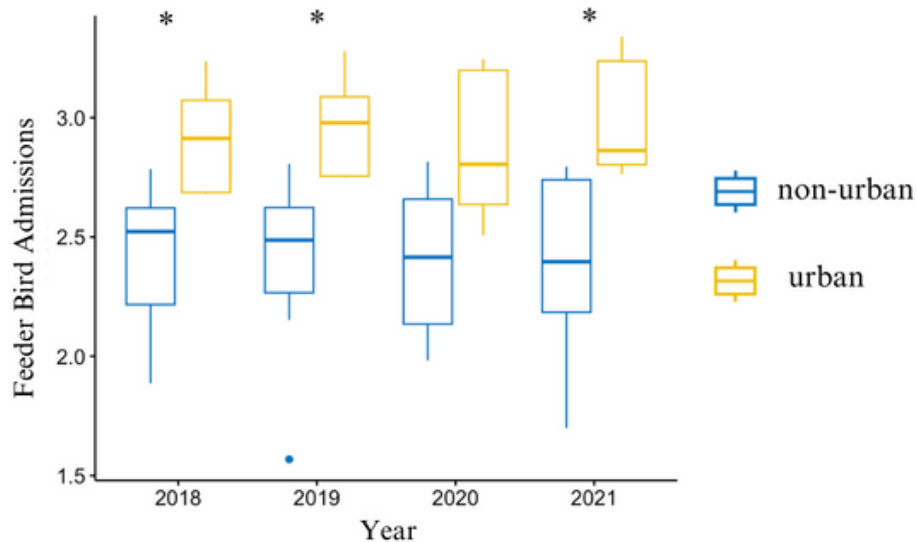


Figure 12. Log transformed annual admissions of bird-feeder associated species to urban and non-urban wildlife rehabilitation centers.

Species	Total Admissions	df	<i>t</i>	<i>P</i>	2018	2019	2020	2021
Blue Jay	1494	9	2.58 - 4.44	<0.01 - 0.03	**	**		*
European Starling	3548	10	2.55 - 3.03	0.01 - 0.03	*	*		
Northern Flicker	489	7	2.97 - 2.98	0.01 - 0.02		*		*
Mourning Dove	4263	10	2.47 - 2.64	0.02 - 0.03	*	*		
Yellow-bellied Sapsucker	451	6	2.46 - 3.12	0.02 - 0.05		*	*	*
House Sparrow	6368	10	2.52 - 2.54	0.03	*	*		
Red-bellied Woodpecker	425	9	2.65	0.03	*			
Dark-eyed Junco	370	7	2.68	0.03				*
White-throated Sparrow	1864	5	3.19	0.03				*
American Robin	5935	10	2.35	0.04				*
Hermit Thrush	337	5	2.78	0.04				*

Table 6. Bird-feeder associate species with higher admissions to urban centers (indicated with * or **) across the 12 wildlife rehabilitation centers in the Northeast, Mid-Atlantic, and Midwest from 2018 to 2021. (* indicates p value < 0.05, ** indicates P < 0).

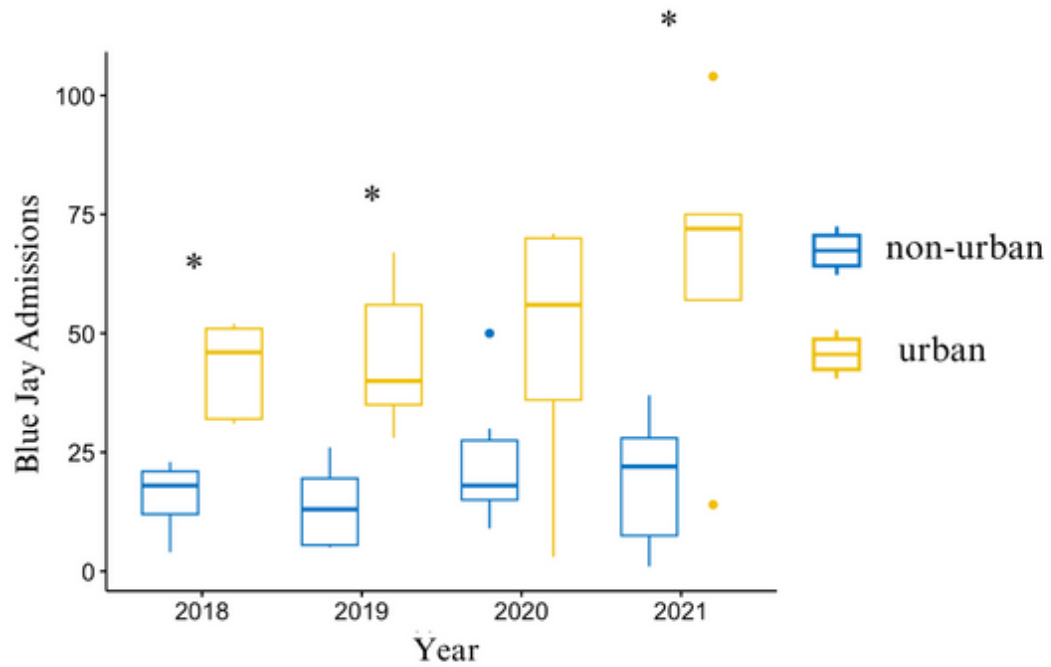


Figure 13. Annual admissions of Blue Jays to urban and non-urban wildlife rehabilitation centers.

DISCUSSION

Little evidence was found to support widespread influences of the COVID-19 pandemic on wild bird admissions to rehabilitation centers from 2018 to 2021. Apparent responses to the onset of the pandemic were variable, and while some centers experienced a decrease in admissions associated with this time period, others received an increase in admissions (Figure 1). This may trace back to underlying differences between centers including size, funding, and public awareness, or could relate to factors not examined within this study such as local lockdown measures.

Similarly the nature of the data does not communicate underlying drivers of admissions. In a simplified view, there are three steps that lead to an admission to a rehabilitation center: 1) an animal is injured or otherwise in need of aid, 2) said animal is found by someone who decides to take it to a rehabilitation center, and 3) the rehabilitation center is able to admit that animal for care. Potential admissions may meet any of these criteria; however admission data only show cases where all of these steps were followed through. If an animal is found and the rescuer does not seek treatment for it or does not have the resources to know about and bring it to a rehabilitation center it is a potential but not realized admission. During the COVID-19 pandemic this could have taken the form of rescuers not taking birds to centers out of health and safety concerns. Potential admissions also represent animals that were brought to centers and otherwise not treated there, including rehabbers referring rescuers to other centers or the animal brought in not being a species treated at that facility.

The Northeast, Mid-Atlantic, and Midwest also did not have any patterns of influence from COVID-19 between years, and the same can be said for urban, suburban,

and rural rescue areas. Months that were found to have differences in admissions between years included three winter months that constitute a small amount of yearly admissions. Notably these months found to have greater admissions came after March 2020, and could indicate potential increases in winter admissions during the first year of the pandemic. December 2020 is also when the COVID-19 vaccinations began in the United States, which could have led the public to feel safer interfacing with others (Assistant Secretary for Public Affairs (ASPA), 2024).

Admissions due to birds being hit by vehicles were not found to differ between years or within the 2020 months of decreased human travel. It's possible that the decrease in traffic would be more impactful to animals that are limited to traveling on the ground rather than flying. This is supported by the small proportion of avian admissions due to vehicle collisions (8.1%), indicating this may not be the biggest contributor to bird admissions, or most bird-vehicle collisions do not make it to rehabilitation centers.

Annual differences in admissions for the order Podicipediformes were based on 64 admissions and may have been influenced by an outlier from 2018. Admissions for Sittidae may have the same challenge of being a small sample with a 2018 outlier; however, an increased median for annual admissions from 2019 to 2020 may support the idea of increased admission during the onset of the pandemic. Though the White-breasted Nuthatch (*Sitta carolinensis*) and Red-breasted Nuthatch (*Sitta canadensis*) are common bird feeder users in northeast North America, neither had sufficient sample sizes to be included in the 'feeder' species analysis. The apparent increase in Sittidae admissions could point to these species being admitted more frequently due to more human bird feeder engagement during lockdowns. Feeder birds show greater admissions to urban

centers in all years except 2020, indicating a possible increase of feeder birds to non-urban centers and/or a decrease to urban centers. The change in Fringillidae admissions could support the idea of increased admissions associated with the pandemic, and perhaps a delayed response resulting in the increase we see in 2021, however the median admissions between years are largely the same.

We can see variation in annual admissions between centers reflected in taxa such as Turdidae to urban centers where there is a decrease in the minimum and increase in the maximum number of admission in 2020 compared to other years. This extended range coupled with a decrease in the median annual admissions in 2020 led to similar admissions of Turdidae to both urban and non-urban centers (Figure 9). This similarity did not appear in 2019 or 2021 for Turdidae admissions. Blue Jays also follow this pattern of admission; a decrease in annual urban admissions to some centers, as well as the increase of admissions to one non-urban center, make urban and non-urban admissions different in all years but 2020.

Urban centers received more mean annual bird admissions, and more passerines, than non-urban centers (Figure 4, Figure 8). Birds rescued from urban areas are more likely to be brought to urban centers, which would theoretically be the closest option. Due to this nearly 80% of urban rehabilitation center admissions come from urban areas, with other admissions being predominantly suburban, and only a small fraction of admissions coming from rural areas. Non-urban centers however receive a majority of their admissions from suburban areas, with rural admissions also contributing a fair proportion, and only around 8% of admissions coming from urban areas. Rural areas do

not make up a majority of admissions to wildlife rehabilitation centers, this could be due to lower population densities, greater distances to centers, or fewer synanthropes.

Mean care time was found to be greater for birds that received treatment at non-urban centers compared to urban centers. This is likely due to the greater number of admissions to urban centers, where cases have to be handled quicker to allow for more birds to be treated. Though cases that were euthanized on arrival did not show significant differences between years, urban centers euthanized more cases on arrival than non-urban centers all years except 2020. This could be due to more cases euthanized on admission at non-urban centers and/or fewer at urban centers (Figure 11).

Species richness of admissions also highlights differences between centers; for urban centers the top six most frequently admitted species make up 50% of admissions whereas for non-urban centers this is the top 13. In addition, within urban admissions the Rock Pigeon (*Columba livia*) comprises a quarter of all admissions. This same species contributes to only around 1% of non-urban rehabilitation center admissions. Rock Pigeons, also known as feral pigeons, have a history tied with human domestication and a dependence on human structures today. They are found in high abundance in cities and it is likely due to both this and high human densities within cities that they are admitted to urban centers so frequently.

These patterns make sense within the context of realized admissions. In order for birds to be admitted to rehabilitation centers they must first be found by someone, which is highly dependent on chance. More people within an area means a higher chance of that bird being found, and we can see this in the correlation between population density and rehabilitation center admissions (Figure 5). This also shapes the birds that we see

admitted to both urban and non-urban centers, which tend to be synanthropes.

Synanthropes live in close proximity and often benefit from human structures and environmental modifications. Within the 30 most frequently admitted bird species 25 are full, casual, or tangential synanthropes (Johnston, 2001) (Table 2, Table 4). This pattern reveals that birds most often admitted to wildlife rehabilitation centers are ones most associated with human structures.

This study provides valuable insights into some differences among wildlife rehabilitation centers, and expands the body of research characterizing the wild birds brought to them. Studies that compile long-term data are needed to examine trends, something this study is limited by. Understanding the context of these types of datasets could be applied to a variety of conservation issues such as impacts of domestic cats on wild birds using data from wildlife rehabilitation centers (Demezas & Robinson, 2021, McRuer et al., 2016). The persistent abundance of synanthropic wild birds within this study show that these species would be good candidates for future studies using wildlife rehabilitation data. Though these species are often of low conservation concern, they could be used to examine anthropogenic impacts of urban activity. The resiliency of rehabilitation centers amidst such precarious times demonstrates a commitment to aiding the wildlife of our world. Organizations like WILD-One that work to connect rehabilitation centers as a larger network and collect these data are invaluable for this research and are paving the way to expand this work in the future.

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APPENDICES

Appendix A: Figures

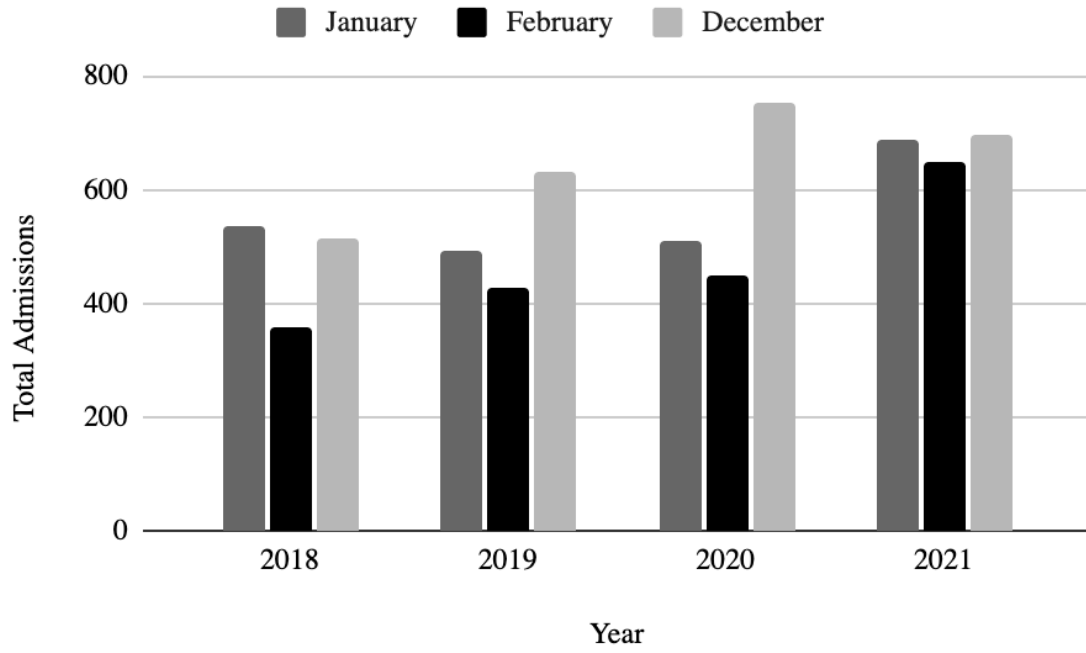


Figure A.1. Total admissions of wild birds to the 12 wildlife rehabilitation centers during January, February, and December.

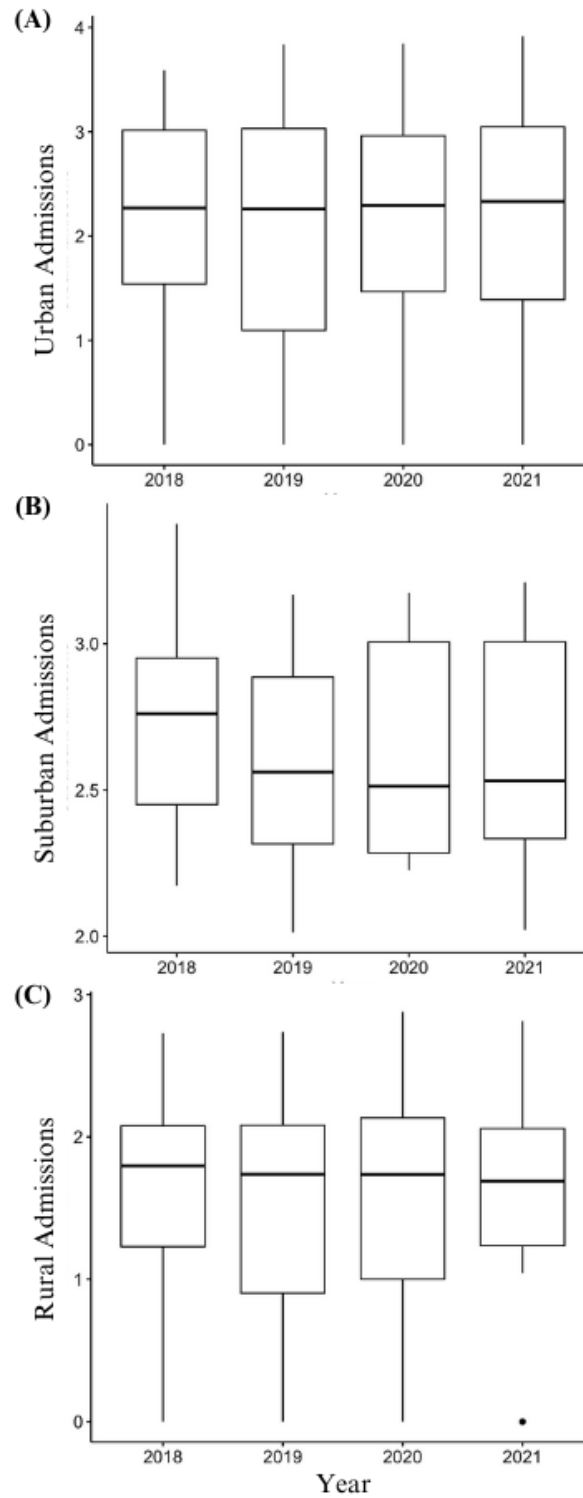


Figure A.2. Log transformed annual admissions rescued from urban (A), suburban (B), and rural (C) areas.

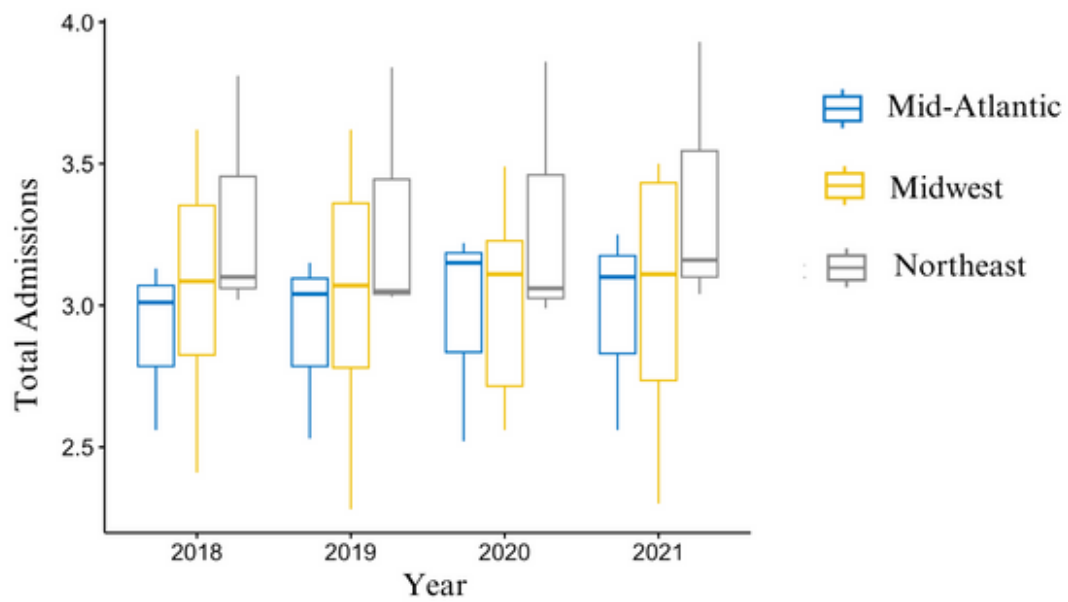


Figure A.3. Log transformed annual admissions to rehabilitation centers in the Northeast, Mid-Atlantic and Midwest.

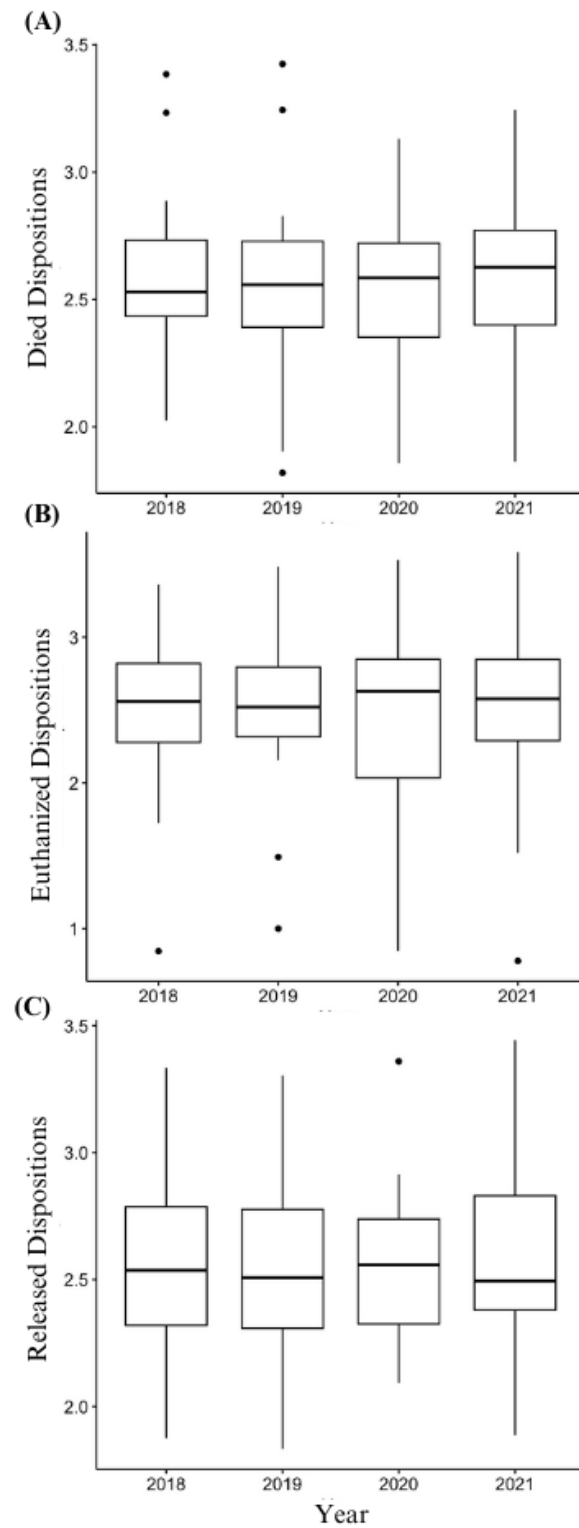


Figure A.4. Log transformed died (A), euthanized (B), and released (C) admissions from 2018 to 2021.

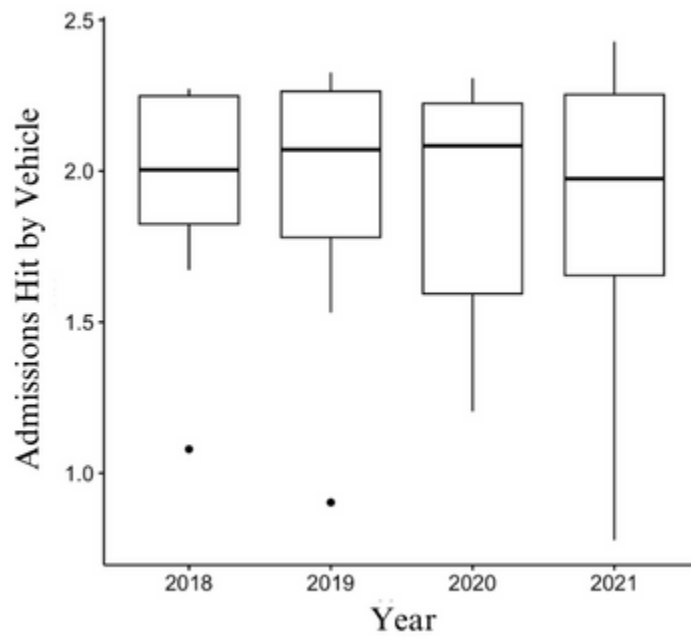


Figure A.5. Log transformed annual admissions of birds due to vehicle collisions.

Appendix B: Tables

Variable	Definition	Source
Organization Name	The wildlife rehabilitation where the admission record was sourced	Rehabilitation submission
Organization State	The state where the organization record is located	Rehabilitation submission
Organization Jurisdiction	The county where the organization is located	Rehabilitation submission
Organization RUCC	The rural urban continuum code of the county where the organization is located	USDA urban-rural continuum code, 2024
Organization Delineation	The classification of the organization jurisdiction as urban or non-urban	(see methods)
Year Admitted	The year the bird entered into the care of the rehabilitation	Rehabilitation submission
Case Number	Unique case identifier number	Rehabilitation submission or assigned if not present
Date Admitted	The date the bird entered into the care of the rehabilitation	Rehabilitation submission
Common Species Name	The common name of the bird	Rehabilitation submission
Family	Family name of bird	Chesser, 2024
Order	Order name of bird	Chesser, 2024
Rescue State	The state where the bird in need of rehabilitation was found	Rehabilitation submission
Rescue Jurisdiction	The county where the bird in need of rehabilitation was found	Rehabilitation submission
Rescue RUCC	The rural urban continuum code of the county the bird was found in	USDA urban-rural continuum code, 2023
2020 Jurisdiction Population	The population of the county the bird was found in	USDA urban-rural continuum code, 2023
Jurisdiction Size	The area in square miles of the county the bird was found in	US Census Bureau, 2020
Jurisdiction Population Density	The population density of the county the bird was found in	US Census Bureau, 2020
Rescue Delineation	The classification of the rescue jurisdiction as urban, suburban, or rural	(see methods)
Date Dispositioned	The date care for the admitted bird ended	Rehabilitation submission
Disposition	The outcome of care	Rehabilitation submission
Duration of Care	The time spent receiving care for admitted birds	(see methods)

Table B.1. Variables within the compiled dataset from wildlife rehabilitation centers including definitions and sources. (<https://www.census.gov/quickfacts/fact/table>)

RUCC Code	Description
1	Metro - Counties in metro areas of 1 million population or more
2	Metro - Counties in metro areas of 250,000 to 1 million population
3	Metro - Counties in metro areas of fewer than 250,000 population
4	Nonmetro - Urban population of 20,000 or more, adjacent to a metro area
5	Nonmetro - Urban population of 20,000 or more, not adjacent to a metro area
6	Nonmetro - Urban population of 5,000 to 20,000, adjacent to a metro area
7	Nonmetro - Urban population of 5,000 to 20,000, not adjacent to a metro area
8	Nonmetro - Urban population of fewer than 5,000, adjacent to a metro area
9	Nonmetro - Urban population of fewer than 5,000, not adjacent to a metro area

Table B.2. USDA urban-rural continuum codes and descriptions (US Department of Agriculture 2024)

Rank	Species	Admissions
1	Rock Pigeon	16384
2	House Sparrow	6368
3	American Robin	5935
4	Mourning Dove	4263
5	European Starling	3548
6	House Finch	2113
7	White-throated Sparrow	1864
8	Northern Cardinal	1564
9	Blue Jay	1494
10	Carolina Wren	1183
11	Common Grackle	1153
12	American Crow	785
13	American Goldfinch	763
14	Eastern Bluebird	654
15	Cedar Waxwing	591
16	Song Sparrow	579
17	Northern Flicker	489
18	Yellow-bellied Sapsucker	451
19	Brown-headed Cowbird	429
20	Red-bellied Woodpecker	425
21	Chipping Sparrow	419
22	Downy Woodpecker	419
23	Dark-eyed Junco	370
24	Wild Turkey	349
25	Northern Mockingbird	344
26	Hermit Thrush	337
27	Brown Creeper	305
28	Black-capped Chickadee	260
29	Ruby-crowned Kinglet	247
30	Tufted Titmouse	243

Table B.3. Bird-feeder associate species identified by project feederwatch used in analysis

Time Period	Disposition	Admissions	Total Care Days	Maximum Care Days	Mean Total Care Days	Total Care Days SD	Non-Zero Care Day Admissions	Mean Non-Zero Care Days	Non-Zero Care Days SD	Zero Care Day Admissions
2018 - 2021	Euthanized	30857	121243	499	3.93	14.81	8419	12.58	17.90	22327
	Died	27562	88804	364	3.24	11.45	13578	6.54	15.60	13868
	Released	26962	850874	465	31.68	31.63	25190	33.78	31.56	1672
	Total	88684	1103163	499	12.55	25.07	49504	22.28	29.98	38374
2018	Euthanized	6299	32305	303	5.14	16.87	2078	12.20	17.23	4155
	Died	7488	26497	257	3.57	12.58	3634	5.69	10.00	3741
	Released	6894	227756	393	33.09	33.42	6163	34.90	28.43	654
	Total	21280	297628	393	13.99	26.77	12597	23.63	31.35	8683
2019	Euthanized	7000	32743	368	4.68	14.23	2244	12.55	16.04	4514
	Died	7738	23324	246	3.03	9.68	3567	5.73	8.78	4104
	Released	6473	194507	342	30.18	28.75	5970	31.52	25.89	441
	Total	21752	260118	454	11.96	23.05	12336	21.09	27.29	9415
2020	Euthanized	8402	26468	499	3.15	15.50	1818	10.95	14.94	6536
	Died	5455	17789	306	3.26	11.16	2865	5.27	9.31	2560
	Released	6273	198659	336	31.72	32.39	5898	31.43	26.96	296
	Total	20928	255076	499	12.19	25.83	11400	22.38	31.57	9527
2021	Euthanized	9156	29733	344	3.25	12.90	2232	13.32	23.41	6921
	Died	6881	21194	364	3.09	12.18	3405	6.23	16.72	3463
	Released	7322	229952	465	31.62	31.62	6991	32.89	31.59	281
	Total	23918	290350	465	12.14	24.55	13171	22.05	29.60	10735

Table B.4. Died, euthanized, and released outcomes and care time of wild bird admissions to the 12 urban and non-urban wildlife rehabilitation centers in the Northeast, Mid-Atlantic, and Midwest from 2018 to 2021.

AUTHOR'S BIOGRAPHY

Thea Tengstrom was born in Atlanta, Georgia on April 21st, 2002. She graduated from Dekalb School of the Arts in 2020. During 2019 and 2020 she volunteered at a wildlife rehabilitation center which inspired her to conduct this project. Majoring in wildlife ecology, Thea has a minor in forest ecosystem management. She is a member of Xi Sigma Phi and the UMaine chapter of the wildlife society. During her senior year she was the vice president of the black bear beekeepers.

Upon graduation, Thea plans to undertake seasonal technician work before pursuing an advanced degree with wildlife research. She one day hopes to find a career in wildlife rehabilitation or environmental education.