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IN THIS ISSUE:

ABOUT THE JOURNAL

THE ***Journal of Wildlife Rehabilitation*** is designed to provide useful information to wildlife rehabilitators and others involved in the care and treatment of native wild species with the ultimate purpose of returning them to the wild. The journal is published by the International Wildlife Rehabilitation Council (IWRC), which invites your comments on this issue. Through this publication, rehabilitation courses offered online and on-site in numerous locations, and an annual symposium, IWRC works to disseminate information and improve the quality of the care provided to wildlife.

On the cover:
Magellanic penguin pair (*Spheniscus magellanicus*).

Left:
A least tern provides fresh catch to its chick *(Sternula antillarum).*

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Volume 35(3)

CONTENTS

EDITORIAL

Compassionate Rehabilitation, Compassionate Conservation

In July, I attended a conference on compassionate conservation, a concept with strong connections to wildlife rehabilitation. Compassionate conservation ensures "the long term survival of species as part of functional ecosystems while avoiding human intervention and minimizing human induced suffering." This definition includes the general guidelines that conference speakers agreed define compassionate conservation: first do no harm, individuals are important, do not categorize animals, and coexist.

All actions have intended and unintended consequences. David Fraser of the University of British Columbia asserts that a core principle of compassionate conservation is to be mindful of the harm we do, even when striving for the greater good. We can achieve this by defining and following ethical guidelines and models that consider human, animal, mental, physical, and psychological welfare.

Long term survival of species as part of functional ecosystems

Rehabilitation aspects of ensuring functional survival include sharing our knowledge and observations with the greater conservation community. We must collaborate in multidisciplinary efforts to protect existing communities and, where appropriate, reintroduce species. Guiding principles of species survival combine the science and ethics of conservation, considering the whole animal and how it fits into an environment.

Avoiding human intervention

Renesting, reuniting, and educating the public on natural wildlife behavior functions are important wildlife rehabilitation tools to avoid human intervention. Wildlife rehabilitators know that the best outcome for many wild animals is to not come into human care. We can continue to refine and perfect our skills, so only those with true need, where human intervention can decrease harm, will come into rehabilitation. As Will Travers states succinctly, we must intervene when it is truly necessary and not because it is expedient.

Guiding principles here are coexistence and not categorizing animals. This second point may need some clarification. Categorizing here means lumping animals into broad groups such as pest, introduced, and native–black and white labeling of species as either good or bad. This practice, so compelling to humans, oversimplifies a species' role in the environment. For instance, the dromedary camel is defined as an invasive species in Australia and some policy makers and conservation biologists advocate for their destruction. But camels are extinct in the wild in their native mid-eastern habitat, while they are thriving in the wilds of Australia. Additionally, the deep footprints camels make in the Australian outback become vernal pools, attracting native wildlife and plants, creating habitat.

Compassionate conservation looks at the nuanced situation and considers all aspects of the animal's behavior and ecosystem impact, as well as the positive and negative impacts of action.

Minimizing human-induced suffering

As Renee Schott discussed in the Journal of Wildlife Rehabilitation issue 35(2), it is rarely, if ever, possible to do no harm, but we must be cognizant of the harm our actions may cause and strive to reduce suffering. Rehabilitation plays a big role here; we care for the individual. Within rehabilitation practices, we must also consider how we can best minimize suffering, managing stress and pain as well as the animal's external injuries.

The guiding principles in reducing suffering include the doubtful adage "first do no harm" [let's read as *minimize* harm] and individuals are important. Sophie Muset,

CONTINUED ON PAGE 6

Further support from US in preventing traffic in wildlife

Washington, DC, USA (August 11)—As part of the effort to stop the illegal trade of wildlife products in the United States, US Secretary of the Interior Sally Jewell today praised the formation of the US Wildlife Trafficking Alliance that will bring together major companies, foundations, and nonprofit organizations to work with the US government in efforts to reduce US demand for illegal elephant ivory, rhino horn, and other wildlife products.

A number of companies have already adopted policies and procedures that align with the goals of the Alliance. Companies such as eBay, Facebook, and Google have been helping with initial Alliance activities.

"We are committed to a multi-pronged fight against wildlife trafficking that includes working to reduce demand and sales of illegally traded ivory and other wildlife products right here at home," said Secretary Jewell, who serves as co-chair of the President's Task Force on Wildlife Trafficking. "To put an end to this scourge of killing and trafficking rare and iconic wildlife, we need the help of companies and others outside the government."

Under the leadership of David J. Hayes, the Alliance brings together all elements of civil society, including interested companies, foundations, and nonprofit organizations to work with the US government to accomplish the goals of:

- Raising public awareness of the scope of the wildlife trafficking crisis, including the devastating impact of poaching and illegal trade on elephants, rhinos, tigers and other irreplaceable species, and the traffickers' links to corruption, organized crime, and terrorist organizations;
- Reducing consumer demand for illegally acquired wildlife and wildlife products by raising public awareness; and
- Mobilizing companies to adopt best practices to ensure that their merchandise does not contain parts or products from illegal wildlife and that their goods and services are not being utilized by wildlife traffickers.

IN MEMORIUM

Walter Crawford (February 3, 1945—July 17, 2015)

PHOTO © TOM ROLLINS PHOTOGRAPHY.

Walter Crawford was the well-known founder and exective director of the World Bird Sanctuary. He was an influence on several generations of wildlife rehabilitators, always willing to lend a hand and advice. Walter was a past board member of IAATE and NWRA and a fixture at many a rehabilitation conference. This paraphrased summary of an interview with Walter at IWRC's 1998 conference conveys his irrepressible essence: "Walter Crawford was a man of simple needs and complex dreams. 'A wise man knows everything. A shrewd man knows everybody.' Walter may have had to kiss a lot of toads to make his dreams come true, but he remains a prince."

Sharnelle Fee (September 14, 2015)

It is with the greatest sadness that the Wildlife Center of the North Coast announces the passing of its founder and Director Sharnelle Fee at age 68. She passed quietly and comfortably in the company of her family on September 14, in Astoria, Oregon.

Her dedication to all wildlife and an overwhelming sense of responsibility for seabirds transformed her rather ordinary life in her 50s as a paralegal in Portland, to a fearless, tireless, and remarkable life as a federally-permitted rehabilitation specialist. She developed a large facility on 100 acres she purchased with her own money, and began the long and often frustrating process of teaching others the value of protecting and taking care of the wildlife we share with our very special environment.

She touched innumerable lives in the process, many of whom love to share their "Sharnelle" stories with anyone that will listen. Few ever forgot seeing her in action, either rescuing a bird in the surf or bay, discussing the dangers of human-to-bird interactions with folks in parking lots, or teaching a classroom of children and seeing their eyes light up when she spoke.

Sharnelle left a legacy that the new director, Josh Saranpaa, the many volunteers, and the north coast community are determined to continue.

Global Ranavirus Reporting System Announced

New York, New York, USA (August 4)—EcoHealth Alliance, a nonprofit organization that focuses on local conservation and global health issues, and the US Forest Service announced the release of an online disease tracking portal known as the Global Ranavirus Reporting System (GRRS). Ranaviruses are emerging pathogens capable of causing disease in amphibians, reptiles, and fish. "Ranaviruses are a global

CONTINUED ON PAGE 6

Compassionate Rehabilitation

CONTINUED FROM PAGE 4

director of the Jane Goodall Institute of Canada, lists six key reasons individuals matter. They increase the resilience capacity of the community, increase community knowledge via their unique abilities, are significant to the social dynamics of the group, provide potential conservation tools, and conservationreceives better support from local communities when individuals are known and emphasized. Individuals are also important because they exist and because they suffer.

What we might not consider overtly in wildlife rehabilitation is minimizing human suffering. An innovative wildlife rehabilitation center and animal sanctuary in India, Wildlife SOS, sustainably reduces both the suffering of sloth bears kept for human entertainment and enhances the lives of the would-be captors, assisting them with education and funding for alternative employment options.

Conservation scientists and wildlife rehabilitators have a tool kit available to follow these principles. Perhaps the greatest item in our tool kit is the ability to step back and evaluate our actions before, during, and after. In addition, there are models and guidelines being developed to assist in compassionate conservation. Treat the whole animal and do not disregard the human. Ron Kagan of the Detroit Zoo remarks, "There is a big difference between care and welfare." We must keep human and animal welfare at the forefront as we practice animal care through wildlife rehabilitation.

More resources can be found at compassionateconservation.net/resources.

(All quotes from speakers at the 2015 Compassionate Conservation Conference in Vancouver, BC.)

Kai Williams
Executive Director

News

CONTINUED FROM PAGE 5

problem, much like malaria or AIDS. Mapping its distribution will help preserve biodiversity," stated Dr. David Lesbarrères, Laurentian University. The GRRS was built on the EcoHealth Alliance's Mantle platform in consultation with the Global Ranavirus Consortium, a network of scientists with ranavirus expertise. The GRRS is an open-source web platform designed for the storage, sharing, and visualization of global ranavirus surveillance data, including diagnostics and genetic isolate differences. The portal is designed to meet the needs of a wide variety of users

PHOTO ©ROB BAER, ALASKA DEPARTMENT OF FISH AND GAME.

A dead young fin whale floats in the Gulf of Alaska, one of more than 30 whale casualties this year thought to be victims of a record-breaking Pacific coast algal bloom.

inclusive of natural resource managers and researchers. Ranavirus scientists in the field or the lab will be able to upload datasets in multiple formats to the system, where they will be stored for easy download and analysis. GRRS users have fine-grained access controls to protect and share their uploaded datasets, and examine datasets in views appropriate to their content (e.g., tables, maps, and charts).

The scientific community is impressed with the capabilities of the GRRS. "The GRRS fills a critical gap in ranavirus research by providing a user friendly platform for data entry and extraction that will be invaluable for researchers and managers seeking to understand ranavirus epidemiology at multiple scales," explained Dr. Jason Hoverman, Purdue University. Dr. Stephen Price of University College London added, "Ranaviruses can have severe impacts on amphibians at the community level and the GRRS provides a great tool to share surveillance data. The GRRS has the potential to provide a stronger link between research and wildlife management."

The GRRS represents a new generation of disease mapping and analysis, with its geospatial references linked to critical case data. Dr. Matt Gray of the Global Ranavirus Consortium stated, "The GRRS will rapidly advance the scientific community's understanding of ranavirus epidemiology, and help natural resource agencies and other organizations respond intelligently to new outbreaks. I am certain the GRRS will become a model for future infectious disease reporting and biosurveillance."

Scientists and veterinarians are encouraged to upload records of ranavirus cases. As more records are added, the true utility of the GRRS will be recognized. Please contribute to discussions on the GRRS at: @EcoHealthNYC, @mantle_io, @RanavirusGRC.

Excessive algal bloom impacts wildlife and humans

Washington, DC, USA (August 6)—A record-breaking algal bloom continues to expand across the North Pacific reaching as far north as the Aleutian Islands and as far south as southern California. Coinciding with well above average sea surface temperatures across the North Pacific and

CONTINUED ON PAGE 33

Post-release monitoring of hand-reared songbirds

Halley D. Buckanoff and Lynn J. Moseley

Blue jay *(Cyanocitta cristata)*.

ABSTRACT: The Valerie H. Schindler Wildlife Rehabilitation Center at the North Carolina Zoo (VHS WRC) initiated a post-release survival study of commonly rehabilitated backyard songbirds in 2010. By the end of 2014, 183 hand-reared songbirds had been color-banded and released. Eleven individuals have been re-sighted, including two northern cardinals *(Cardinalis cardinalis)* observed for more than five months post-release, and one Carolina wren *(Thryothorus ludovicianus)* one year post-release. All re-sighted birds demonstrated normal wild behavior and were distinguishable from their wild counterparts only by their study bands.

KEYWORDS: banding, post-release, songbirds, survival, wildlife rehabilitation

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Introduction

The Valerie H. Schindler Wildlife Rehabilitation Center (VHS WRC) at the North Carolina Zoo, in partnership with faculty emeritus at Guilford College, has been conducting a post-release survival study of commonly rehabilitated backyard, non-migratory songbirds for five years. A search of the literature revealed few studies on post-release survival and/or behavior of hand-reared and rehabilitated songbirds.[1-3] Anecdotal comments suggest that the behavior of hand-reared wild birds is sometimes distinguishable from that of their parent-reared counterparts as they act inappropriately for their sex or species, are unafraid of humans, and/or continue to come to humans for food. We hypothesized that hand-reared songbirds reared in an appropriate, controlled environment using hands-off techniques and limited contact with humans would exhibit appropriate species-specific behaviors post-release to appropriate habitat.

Seven species of birds were chosen for the study based on the frequency of admission numbers, determined by annual data, at the VHS WRC, and the potential for released birds to be easily re-sighted near feeders or around homes. All have non-migratory populations in North Carolina. We intentionally included species with differing dietary needs, size, and niche use as much as possible within the confines of availability based on numbers admitted into care at the VHS WRC so that our study would represent species of varying ecology. The species chosen were American robins (*Turdus migratorius*, AMRO), blue jays (*Cyanocitta cristata*, BLJA), Carolina wrens (*Thryothorus ludovicianus*, CARW), eastern bluebirds (*Sialia sialis*, EABL), mourning doves (*Zenaida macroura*, MODO), northern cardinals (*Cardinalis cardinalis*, NOCA), and red-bellied woodpeckers (*Melanerpes carolinus*, RBWO). Additional limiting factors for species selected for this study included approval by the United States Geologic Survey (Bird Banding Laboratory (USGS BBL)) for species that were not currently being color-banded by other researchers in the area.

Study Area

The geographic study sites were within a 50-mile radius of the North Carolina Zoo in Asheboro, North Carolina (35° 38′ 37N by 079° 46′ 4″W).

Methods

All study birds were admitted to the VHS WRC in their hatch year at fledgling stage or younger, and were hand-raised within the guidelines of the Center by trained staff, volunteers, and interns. Standard protocols included initial assessment for injury or illness at admission time with follow-up by veterinary staff as needed, taking daily weights until birds were eating on their own and gaining weight for at least three days, no talking to or around releasable wildlife, handling only as needed and as little as possible, providing housing for each developmental stage (including pre-release conditioning) that meets or exceeds International Wildlife Rehabilitation Council and National Wildlife Rehabilitators' Association's Minimum Standards, providing natural sounds and species-specific songs with local dialects of the birds within care during daylight hours, using timed lighting to mimic natural conditions, and providing nutritionally-complete diets during all stages of growth and development.

FIGURE 1. Each study subject was given a unique set of metal and colored bands pre-release.

Housing of birds within the VHS WRC Avian Nursery is arranged taxonomically (i.e., mimids are housed next to other species of mimids). In addition, smaller species of birds are never housed next to large species in order to reduce stress. Every effort is made to raise juvenile songbirds with conspecifics regardless of life stage as long as individuals are old enough to thermoregulate outside of the incubator environment. Heating pads are provided on an exterior portion of enclosures. Older hand-reared songbirds have assisted in the rearing/feeding of younger birds while in captive care and presumably help younger birds develop species-specific recognition, vocalizations, and behaviors.

Prior to release, birds were banded with a numbered aluminum band and three colored bands in a unique combination for specific identification of individuals (Fig. 1). Bird banding is regulated by the USGS BBL and requires a federal permit. Both authors possess appropriate permits for this project.

All post-release data were compiled through periodic observations of banded birds. If a released bird was re-sighted, we recorded behavioral data according to the following categories: feeding (F), preening/bathing (P/B), carrying nesting material (CNM), resting (R), other comments (O). If feeding was observed, we noted whether it occurred at an established feeder. We also recorded whether the bird was with other banded or unbanded birds. We used this information to help determine whether a released bird demonstrated appropriate species-specific affiliations.

During 2010, the study's first year, we attempted to engage the public to be "citizen scientists" and participate in the study. Whenever possible, birds were released by the person who had rescued the bird and brought it to the VHS WRC. Birds were transported to their original capture site in vented paper bags and hard-released. A total of 43 birds were banded with metal and color bands and released (Table 1). However, no members of the public who released the birds reported any data and, upon inquiry, the participants stated that they had not looked vigilantly for the banded birds.

The following year, in 2011, volunteers and interns at the VSH WRC conducted releases. Birds were again transported in vented paper bags to

TABLE 1. SPECIES OF BIRDS AND NUMBERS OF INDIVIDUALS OF EACH SPECIES REHABILITATED, BANDED, RELEASED, AND RE-SIGHTED IN EACH YEAR OF THIS STUDY.

YEAR	AMRO	BLJA	CARW	EABL	MODO	NOCA	RBWO	TOTALS	# BIRDS RESIGHTED
2010	18	3	3	13	1	2	3	43	0
2011	8	4	14	6	6	0	4	42	0
2012	12	1	5	2	1	5	2	28	1 NOCA
2013	15	6	13	7	0	1	3	45	5 CARW
2014	6	0	7	1	5	4	2	25	1 CARW 2 NOCA 2 MODO
TOTALS	59	14	42	29	13	12	14	183	11

appropriate habitats and hard- released. A total of 42 birds were aluminum- and color-banded and released (Table 1). Once again, no data were acquired due to lack of searching for released birds.

In 2012, study birds were released and monitored by the two authors alone and only at two locations because of the lack of re-sight data from previous years. Sites chosen offered suitable habitat for study birds (those species had been observed routinely at each site) and could be easily monitored. Feeders and landscaping were maintained at both locations to provide easy viewing of banded birds. In the first half of the season (mid-June to mid-July), birds were transported in vented paper bags and hard released; during the second half of the season (mid-July to mid-September) birds were transported in Exo Terra Explorariums® soft-sided hanging enclosures (Fig. 2). The enclosures were hung in visual distance of a feeder and left, depending on time of day, several hours to overnight. The door to the enclosure was then unzipped and the birds were allowed to leave at will. We referred to this release type as pseudo-soft release. The change in release type was made to reduce the presumed stress of a hard-release into an unfamiliar location rather than to test the validity of either release method. These methods were continued during 2013 and 2014.

Results

Years 2010 and 2011 yielded no re-sightings (Table 1). In 2012, one hard-released NOCA and one pseudo-soft-released NOCA were the only birds re-sighted of the 28 banded and released birds; the hard-released NOCA was re-sighted up to five months after release (Fig. 3). The ethogram results suggest that both exhibited appropriate behaviors for a normal, wild bird.

In 2013, five Carolina wrens (CARW) were repeatedly sighted post-release, one of which continued to be observed for over a year (Table 1; Fig. 4). Four of the re-sighted CARW were released on 20 June 2013 (Group 1). The fifth re-sighted CARW was from Group 2, released on 11 Sep 13 (Fig. 3); this individual was re-sighted almost daily for approximately one month. The activity log for all five re-sighted CARW included reports of interactions with non-banded CAWR, feeding at feeders, foraging in brush, bathing/preening, and alarm calls when observers approached. Ethogram comments for the single re-sighted CARW from Group 2 also included molting; during this period, it was caught by a dog and killed.

In 2014, 25 individuals were banded and released at the two sites used in 2013. Two NOCA, two MODO, and another CARW released during the 2013 season were re-sighted (Table 1), all of which exhibited species-specific behaviors. As of the end of 2014, the two NOCA were still being observed occasionally (Fig. 3).

Since 2010, 183 hand-reared songbirds have been color-banded and released from the VHS WRC as part of this study. Eleven individuals have been re-sighted, including two NOCA observed for more than five months post-release and one CARW that returned to its release site one year after release. All demonstrated wild behaviors and were distinguishable from their wild counterparts only by their bands.

FIGURE 2. From the second half of 2012 through 2014, birds were transported in soft-sided hanging enclosures for a pseudo-soft release (Explorarium®, Exo Terra, Rolf C. Hagen (U.S.A.) Corporation, Mansfield, Massachusetts 02048).

Discussion and Conclusions

According to the the USGS BBL, approximately 33 million songbirds have been banded to date,[4] with a re-sight/recapture rate of approximately 1%. Our re-sighting frequency of 12%, if the data is excluded from 2010 and 2011 when no released birds were observed, thus greatly exceeds the usual odds of encountering banded birds after release, and supports the success of our methodology of hand-rearing and release.

This study is still in its early stages, as we continue to increase our sample size, locations, and participation in the study. The next phase will involve pseudo-soft release at the VHS WRC where students, volunteers, and interns can become trained observers at a public location with adequate habitat, landscaping, and feeders. With the participation of trained and interested "citizen scientists," we hope re-sighting will increase and will provide enough data for statistical analysis in the future. We will soon begin using telemetry on selected species at the VHS WRC to improve our post-release monitoring. We acknowledge that re-sighting frequency can vary according to the tendency of different species to visit feeders or residentially landscaped areas consistently.

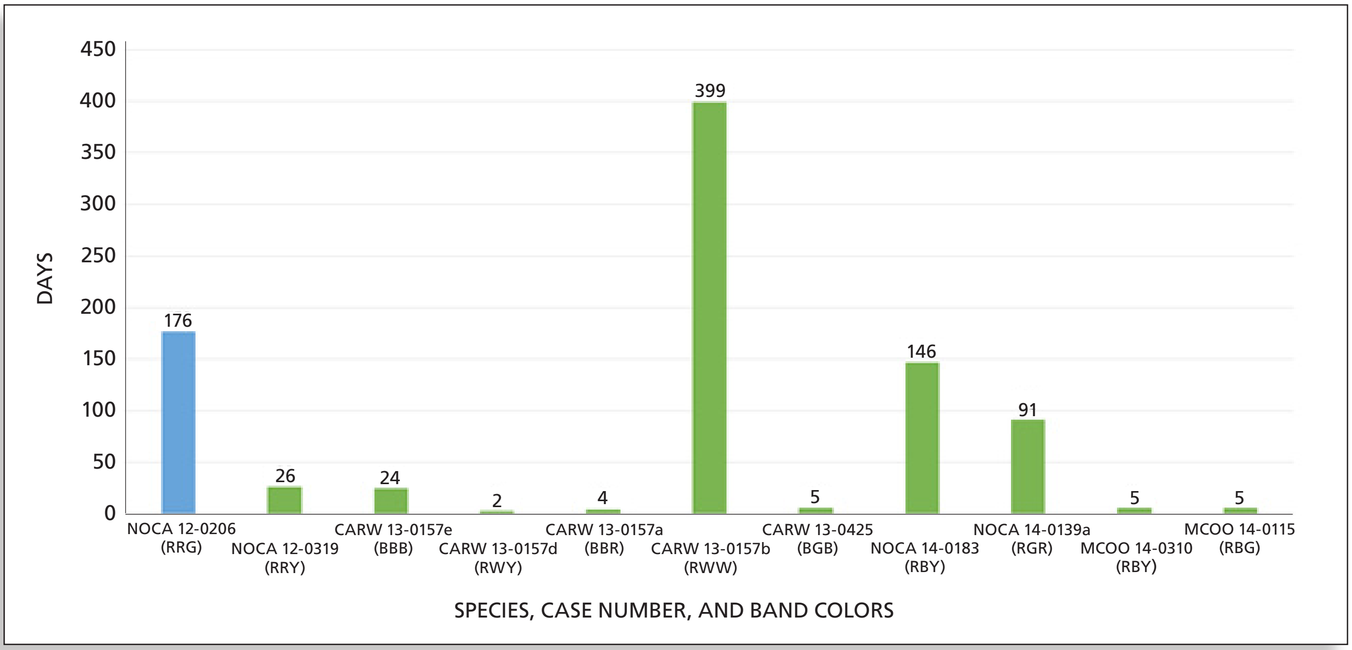

FIGURE 3. Period between release and last sighting (2012-2014).

FIGURE 4. One of the four Carolina wrens (CARW) observed repeatedly post-release.

We believe that understanding the impacts of hand-rearing songbirds on their post-release survival will provide critical information for wildlife rehabilitators, and may serve to test the effectiveness of different techniques for successfully raising songbirds for survival in the wild.

Acknowledgements

We would like to thank the North Carolina Zoo, the North Carolina Zoo Society, Guilford College, and John Gerwin and Keith Jensen of the NC Museum of Natural Sciences for their support in this project, and the staff, volunteers, and interns of the Valerie H. Schindler Wildlife Rehabilitation Center for their assistance and contributions.

About the Authors

Halley D. Buckanoff, BS, CVT, CWR is the lead veterinary technician at the North Carolina Zoo's Valerie H. Schindler Wildlife Rehabilitation Center overseeing rehabilitation practices, center operations, and volunteers/interns. She graduated from Lewis and Clark College in Portland, OR, with a Bachelor's of Science in Biology. She is a Certified Veterinary Technician with 10+ years of emergency, exotic, zoo, and wildlife medicine and husbandry experience. She has completed graduate level course work in animal population management and animal nutrition. She is experienced in field biology, mist-netting, trapping, banding, tracking, and radio-collaring birds. She became a Certified Wildlife Rehabilitator in 2009 and has been a contract instructor for IWRC since 2010.

Lynn J. Moseley, BS, PhD is Charles A. Dana Professor of Biology Emeritus at Guilford College in Greensboro, North Carolina. Prior to her retirement in 2014, she taught courses in ornithology, animal behavior, and vertebrate field zoology, among others. She received her Bachelor of Science degree in Biology from the College of William and Mary, and her PhD in Zoology from the University of North Carolina at Chapel Hill. Her main areas of interest include behavioral ecology, specifically social behavior and communication of vertebrates, especially birds.

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Prevalence of bacteria and fungi in respiratory tracts of seabirds rescued along the São Paulo Southeastern Coast (Brazil) and some blood parameter information

Bruna Del Busso Zampieri, Thais Leandra Siems, Raphaela Sanches de Oliveira, Aline Bartelochi Pinto, Ana Julia Fernandes Cardoso de Oliveira

Magnificent frigatebird *(Fregata magnificens)*.

ABSTRACT: Seabirds can be affected by both bacterial and fungal diseases. Pollution in coastal regions is increasing as a result of domestic sewage and a lack of sanitation. Marine vertebrates can be infected by etiological agents, by water contamination, or by feeding on contaminated prey while foraging. Thus, this study aims to characterize the bacterial and fungal groups found in the respiratory tracts of seabirds from the southeastern coast of Brazil in attempt to identify infectious diseases that may be of risk to humans or other animals sharing the environment. *Staphylococcus* spp. and *Streptococcus* spp. were found to be the most prevalent of the bacteria isolated, while *Candida* spp. and *Aspergillus* spp. were the most frequently isolated fungi. The results suggest possible fungal and bacterial infections due to heterophilia associated with leukocytosis. Fungi appeared to have a higher impact on blood parameters than bacteria did, even though bacteria make up most of these animals' commensal organisms. Some microorganisms, such as *Aspergillus* spp., appear to develop into more severe diseases and to generate higher mortality rates in species that are less frequently found along the Brazilian coast, such as *Spheniscus magellanicus.*

KEY WORDS: seabirds, rehabilitation, zoonoses, bacteria, *Aspergillus* sp, respiratory diseases

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Introduction

Seabirds are predators at the top of food chain. They are crucial to marine ecosystems and can be indicators of environmental changes to these ecosystems.[1] Along the Brazilian coast, four orders of seabirds (*Sphenisciformes, Procellariformes, Pelecaniformes,* and *Charadriiformes*) can be found, with a total of 148 species having been recorded. This large diversity of species provides evidence of the importance for shorebird and seabird conservation worldwide.[2]

In Brazil, there are six species of seabirds frequently found along the coast: magnificent frigatebird (*Fregata magnificens)*, brown booby (*Sula leucogaster)*, kelp gull (*Larus dominicanus),* royal tern *(Thalasseus maxima),* yellow-billed tern *(T. eurygnatha),* and the South American tern (*S. hirundinacea*[3]). There are also oceanic bird species that use Brazilian waters to feed, such as albatrosses and petrels and others seabirds that appear with less frequency like masked booby (*Sula dactylatra)*, Manx shearwater (*Puffinus puffinus)*, and Cape petrel (*Daption capense*).[4] In addition, migratory species such as the Magellanic

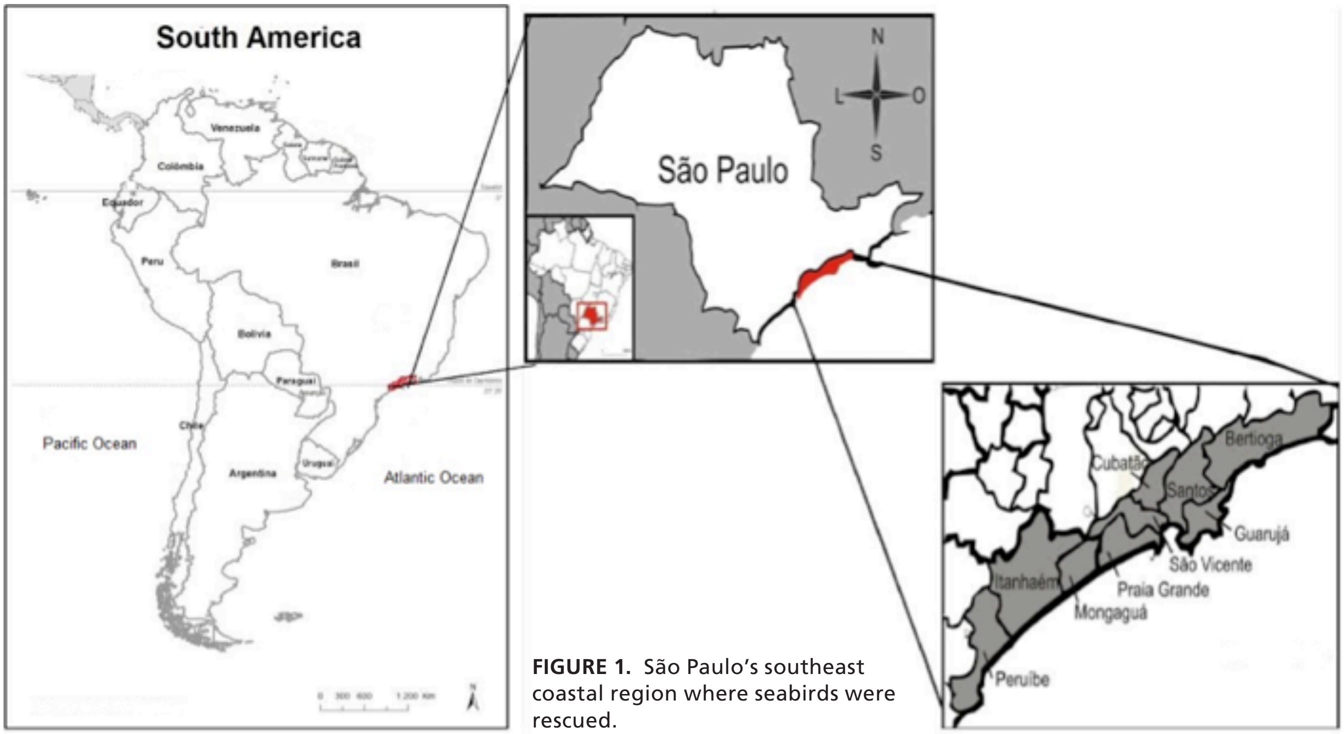

FIGURE 1. São Paulo's southeast coastal region where seabirds were rescued.

penguin (*Spheniscus magellanicus*) are commonly found ill on São Paulo state beaches. Many of these animals are exposed to adverse environmental conditions along their migratory routes and are found to be suffering from dehydration, hypothermia, infections, injuries, or oil exposure.[5]

The Brazilian coast is also highly impacted by human activity. Many kinds of pollution, including domestic and industrial sewage and a lack of sanitation, affect the quality of marine waters and, as a consequence, seabird habitats. In cases of pollution, marine vertebrates can be directly infected by etiological agents when they ingest contaminated water, or indirectly when they feed on contaminated prey while foraging. Therefore, marine vertebrates in general and seabirds in particular are important sources of the pathogens found in both the sea and coastal areas.[6] Similarly, each year, thousands of seabirds around the world are affected by oil contamination, which results in injury or illness. They are often found debilitated in coastal regions and are brought to rehabilitation centers for treatment. When possible, they are released back into the wild.[7]

When these animals are found debilitated along the Brazilian coast, they are taken to rehabilitation centers and are then at risk for contamination by local pathogens.[8]

The respiratory tract is one of the systems most frequently affected by infectious diseases, since it is the pathway of exposure for various aerosolized pathogens.[9] Bacterial and fungal diseases can develop in this system and lead to respiratory distress. Furthermore, studies show that respiratory diseases are among the main causes of seabird disease in rehabilitation centers.[10]

Seabirds may also acquire pathogenic bacteria and fungi at rehabilitation centers. Once they are released back into the wild, they may spread potential pathogens to free-ranging seabird populations.[11] Thus, it is important to monitor the presence of these pathogens in rehabilitation centers.

Because of these risks, it is important to study the microorganisms that may contaminate the respiratory tract and interfere in seabird health both before and during the rehabilitation process. These studies will ideally include blood tests to determine the immunological status of the animals analyzed.

However, there is limited information available on reference ranges for blood tests on marine bird species,[12] especially for birds in Brazil. Analyses of bacterial and fungal infections should be performed, as these infections pose significant risks for animals during the rehabilitation process.

When infections are recognized, appropriate action can be taken to treat these animals. These protocols make the rehabilitation process more efficient and allow for faster release. Therefore, these studies ultimately contribute to species conservation.

In light of these factors, this study characterizes the main bacterial and fungal genera isolated from seabirds' respiratory tracts and performs hematological analyses in order to identify infections caused by these etiologic agents.

Materials and Methods

Samples were collected from seabirds that had been found in São Paulo's southeastern coastal region (Fig. 1) and taken to the Marine Animal Rescue and Rehabilitation Group (Grupo de Resgate e Reabilitação de Animais Marinhos - GREMAR) (23°58›01.93»S; 46°10′02.02″O).

One hundred seven seabirds were sampled from the species *Spheniscus magellanicus* (*n* = 49), *Sula leucogaster* (*n* = 31), *Larus dominicanus* (*n* = 18), *Fregata magnificens* (*n* = 6), masked booby (*Sula dactylatra)* (*n* = 1), Manx shearwater (*Puffinus puffinus)* (*n* = 1), and Cape petrel (*Daption capense)* (*n* = 1).

Microbiological Analysis

To isolate microorganisms, tracheal secretion samples were collected using sterile swabs with a transport medium and taken to the Marine Microbiology Laboratory (MICROMAR) at São Paulo State University's São Vicente Campus (UNESP). The swabs were simultaneously inoculated in Sabouraud Agar, Hicrome Agar, and Nutrient Agar for fungal growth, *Candida* spp. growth, and bacterial growth, respectively. After inoculation, the plates were incubated at 37°C for 24–48h for bacteria and *Candida* growth, and at 37°C for 7–14 days for fungi growth.

Bacterial colonies were identified based on their morphology (shape, size, texture, and color), using the Gram method, and through biochemical tests such as urease, catalase, and oxidase according to standard microbiological methods and *Bergey's Manual of Determinative Bacteriology*.[13] The fungi were identified at genus level based on their morphology according to *The Atlas of Introductory Mycology*.[14]

Hematology Tests

Blood was collected for hematological analyses from seabirds only with clinical signs of respiratory diseases (n = 26). A heparin anticoagulant at a ratio of 0.1 ml to 1 ml of blood from the ulnar vein was used for all of the seabirds except for *Spheniscus magellanicus*, in which case the medial metatarsal vein was used. Blood tests were performed on samples from *Sula leucogaster* (n = 1), *Larus dominicanus* (n = 8), *Spheniscus magellanicus* (n = 6), and *Puffinus puffinus* (n = 1).

Several blood parameters were analyzed (hematocrit, serum total proteins, total erythrocyte count, and total and differential leukocytes counts). Hematocrit values were obtained using the microhematocrit method, which indicates the percentage occupied by red blood cells in total blood volume. Hematocrit values were achieved by spinning whole blood in heparinized capillary pipettes in a microhematocrit centrifuge for 5m.

Serum total protein was determined using a clinical refractometer. Total erythrocyte count (red blood cell – RBC) and total leukocyte count (white blood cell [WBC]) were achieved manually using the Neubauer hemocytometer. This method provides an indication of whether there is a bacterial, fungal, or viral infection, because it reveals the number of cells in the immune system.

For differential leukocyte counts, blood smears were stained using Panoptic staining and an optical microscope. Cells were classified as heterophils, eosinophils, lymphocytes, monocytes, or basophils based on their morphology and staining characteristics.[15]

To infer possible hematological changes in the seabirds analyzed, we compared the blood parameters obtained in this study with the reference values from the literature. For species with no reference values, we relied on blood parameters of birds belonging to the same genus.[12, 16, 17]

Results

The bacterial identification results based on samples obtained from 107 seabirds revealed the prevalence of six main genera of bacteria

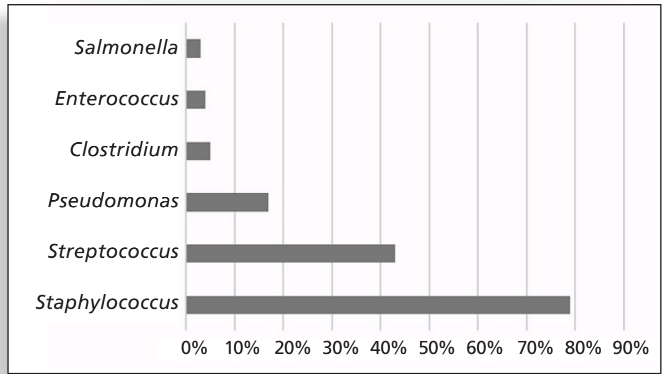

FIGURE 2. Percentage of each genus of bacteria isolated from seabirds.

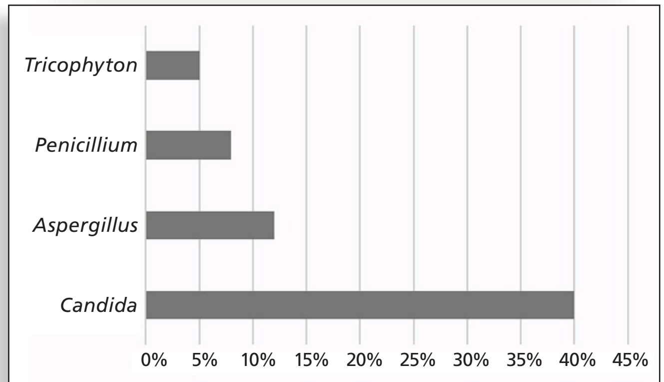

FIGURE 3. Percentage of each genus of fungi isolated from seabirds.

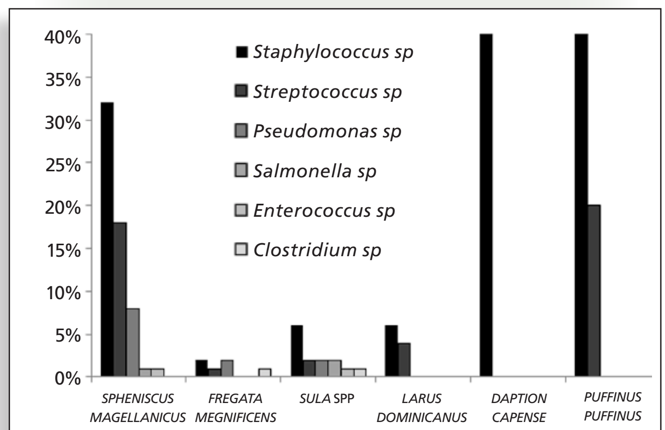

FIGURE 4. Percentage of each genus of bacteria isolated from each seabird species.

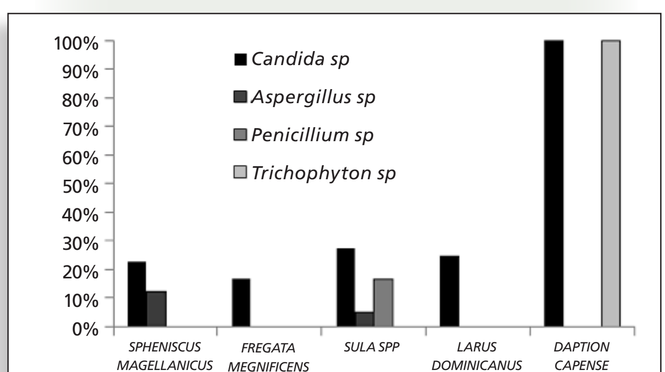

FIGURE 5. Percentage of each genus of fungi isolated from each seabird species.

TABLE 1. HEMATOLOGICAL VALUES OF THE SPECIES ANALYZED IN THIS STUDY: HEMATOCRIT, PROTEIN COUNT, TOTAL RED BLOOD CELLS (RBC), AND TOTAL WHITE BLOOD CELLS (WBC).

	HEMATOCRIT (%)		PROTEIN COUNT (g/dl)		RBC ($x10^6$/μl)		WBC ($x10^3$/μl)	
SPECIES	MEDIA	REF VALUE	MEDIA	REF VALUE	MEDIA	REF VALUE	MEDIA	REF VALUE
Larus dominicanus	40.5 ± 4.33	42.0 ± 0.85	4.90 ± 1.9		1.87 ± 0.57	3.79 ± 0.9	7.75 ± 6.52	10.54 ± 0.42
Sula leucogaster	44.0 ± 5.02	48 ± 3	4.90 ± 0.87	2.7 ± 3	1.84 ± 0.64		7.50 ± 8.43	9.81 ± 2.69
Spheniscus magellanicus	39.0 ± 7.46	42 ± 4	7.20 ± 0.64		1.82 ± 0.77	1.95 ± 0.45	8.50 ± 6.77	12.3 ± 3.4
Puffinus	37.0	48 ± 3	5.00		0.69		3.00	18.18 ± 7.17

TABLE 2. REFERENCE VALUES FOR SEABIRD WHITE BLOOD CELL TYPES.

	REFERENCE VALUE					
SPECIES	LEUKOCYTES					REFERENCE
	MONOCYTES ($x10^3$/μL)	LYMPHOCYTES ($x10^3$/μL)	BASOPHILS ($x10^3$/μL)	EOSINOPHILS ($x10^3$/μL)	HETEROPHILES ($x10^3$/μL)	
Spheniscus magellanicus	1.37 ± 1.282	9.57 ±6.2	0.68 ± 0.5	0.64 ±0.7	14.85 ± 6.8	HAWKEY ET AL. (1989)
Sula sula	0.19 ± 1.23	3.26 ± 1.41	0.16 ± 0.12	0.57 ± 0.40	5.73 ± 2.18	WORK (1996)
Puffinus pacificus	0.45 ± 0.48	12.93 ± 6.21	0.31 ± 0.31	0.48 ± 0.51	4.0 ±2.09	WORK (1996)
Larus michahellis	0.39 ± 0.9	5.35 ± 1.66	0.75 ± 0.9	0.40 ± 0.36	3.61 ± 1.39	GARCIA ET AL. (2010)

(Fig. 2): *Staphylococcus* spp., *Streptococcus* spp., *Pseudomonas* spp., *Enterococcus* spp., *Salmonella* spp., and *Clostridium* spp. *Staphylococcus* spp. was the most abundant genus of bacteria to be isolated. It was found in 79% of the seabirds analyzed. *Streptococcus* spp. was also highly prevalent—it was present in 43% of the seabirds. Meanwhile, the genera *Pseudomonas* spp. (17%), *Enterococcus* spp. (4%), *Salmonella* spp. (3%), and *Clostridium* spp. (5%) were found in lower abundance (Fig. 2).

In the case of fungi, four genera were found to be most prevalent: *Candida* spp. (40%), *Aspergillus* spp. (13%), *Tricophyton* spp. (5%), and *Penicillium* spp. (8%) (Fig. 3).

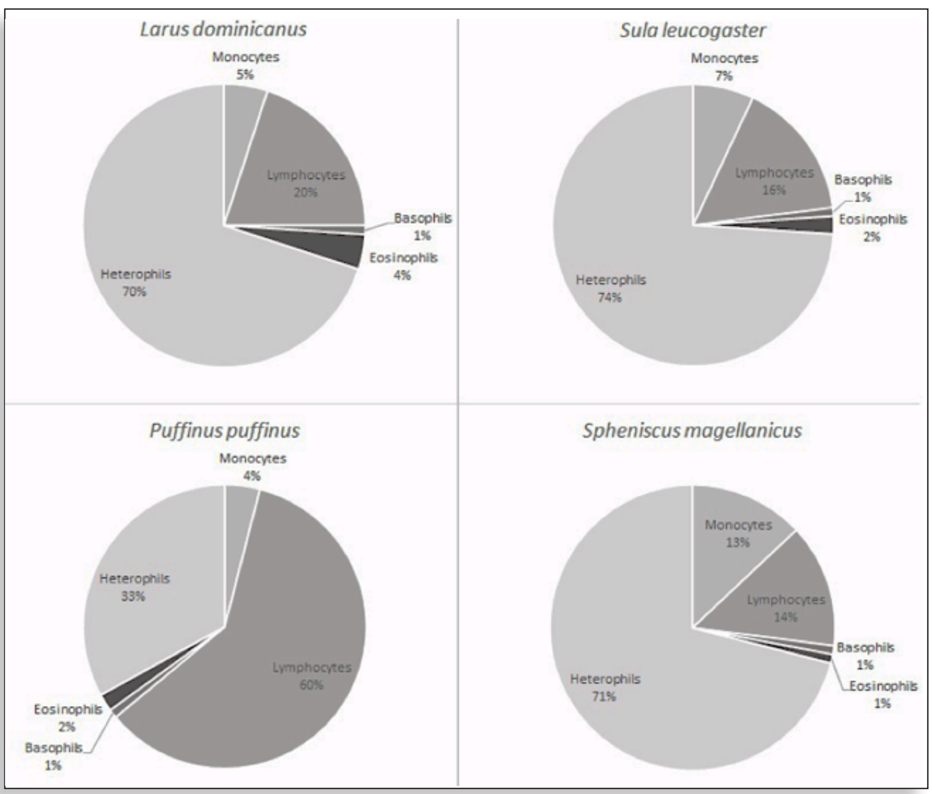

FIGURE 6. Media of differential leukocyte counts of seabirds in this study: (a) *Larus dominicanus;* (b) *Sula leucogaster;* (c) *Puffinus puffinus;* (d) *Spheniscus magellanicus.*

Different bacteria and fungi were found to be dominant in each bird species. *Staphylococcus* sp. and *Streptococcus* sp. were more abundant in *Spheniscus magellanicus*. *Sula* sp. was found to have all of the genera isolated in this study. *Larus dominicanus* specimens had the lowest amount of different genera isolated in their respiratory tracts (Fig. 4). As for the genera of fungi, Candida sp. was found in all seabird species, and *Aspergillus* sp. was found only in *Spheniscus magellanicus* and *Sula* sp. (Fig. 5).

The blood test results obtained in this study on seabirds are shown in Tables 3 and 4. Many of the seabirds were found to have

TABLE 3. HEMATOLOGICAL VALUES OF THE SPECIES ANALYZED IN THIS STUDY: HEMATOCRIT, PROTEIN COUNT, TOTAL RED BLOOD CELLS (RBC), AND TOTAL WHITE BLOOD CELLS (WBC).

SPECIES (*n* = 26)	IDENTIFICATION NUMBER	HEMATOCRIT (%)	PROTEIN COUNT (g/dl)	RBC ($x10^6$ /µl)	WBC ($x10^3$ /µl)
Larus dominicanus	914	47*	5.9	1.08*	19.58*
Larus dominicanus	318	36*	4.8	1.97*	19.5*
Larus dominicanus	319	41	4.9	1.77*	17*
Larus dominicanus	317	44*	5.0	2.05*	7.5*
Larus dominicanus	320	41	5.9	1.44*	5.5*
Larus dominicanus	915	40*	6.1	2.24*	8*
Larus dominicanus	163	33*	4.8	1.22*	4*
Larus dominicanus	913	40*	4.8	2.82*	7*
Sula leucogaster	251	53*	5	2.92	5.5*
Sula leucogaster	259	37*	4.3	1.63	32*
Sula leucogaster	258	44*	4.7	3.3	19*
Sula leucogaster	250	47	4.9	2.15	7.5
Sula leucogaster	104	44*	4.8	1.38	9
Sula leucogaster	555	36*	3.9	1.9	4*
Sula leucogaster	90	50	5.1	1.46	10
Sula leucogaster	103	44*	4	1.18	3.5*
Sula leucogaster	166	42*	5.6	2	14*
Sula leucogaster	95	47	7*	1.84	5.5*
Sula leucogaster	96	43*	5.7	1.67	7
Puffinus	—	37*	5	0.69	3*
Spheniscus magellanicus	205	34*	5.9	1.92	6*
Spheniscus magellanicus	208	35*	7.1	0.35*	9.5
Spheniscus magellanicus	207	43	7.9	2.11	7.5*
Spheniscus magellanicus	260	44	6.9	2.31	10.5
Spheniscus magellanicus	204	45	7.1	0.84*	5*
Spheniscus magellanicus	209	26*	7.2	1.72	23.5*

* Values below or above reference values

red cell volumes, total erythrocyte counts, and total leukocytes counts below the reference values. Fifteen of the 26 seabirds analyzed had low cell volume, a result indicative of anemia. Total leukocyte counts revealed that most of the animals studied had leukopenia (*S. magellanicus* [3], *S. leucogaster* [4] *Puffinus pacificus* [1], and *L. dominicanus* [4]). Many animals also presented with leukocytosis (*L. dominicanus* [3], *S. leucogaster* [3], and *S. magellanicus* [1]) (Table 1).

The differential leukocyte counts revealed that most of the birds had heterophil and lymphocyte values that differed from reference values (Fig. 6).

Several seabirds were found to have high heterophil counts.

TABLE 4. VALUES FOR DIFFERENTIAL LEUKOCYTE COUNTS OF SEABIRDS IN THIS STUDY.

SPECIE (*n* = 26)	ID NUMBER	MONOCYTES ($x10^3$ /µl)	LYMPHOCYTES ($x10^3$ /µl)	BASOPHILS ($x10^3$ /µl)	EOSINOPHILS ($x10^3$ /µl)	HETEROPHILS ($x10^3$ /µl)
Larus dominicanus	914	0.975 (5%)	0.78 (4%)*	6.045 (31%)*	0.78 (4%)	10.92(56%)*
Larus dominicanus	318	0.585 (3%)	4.485 (23%)	0.585 (3%)	0	13.845 (71%)*
Larus dominicanus	319	0.17 (1%)	0.17 (1%)*	0.68 (4%)	0	15.98 (94%)*
Larus dominicanus	318	0.17 (1%)	0.17 (1%)*	0.68 (4%)	0	15.98 (94%)*
Larus dominicanus	320	0.165 (3%)	1.87 (34%)*	0.055 (1%)	1.485 (27%)*	1.925 (35%)*
Larus dominicanus	914	0.96 (12%)	2.64 (33%)*	0.16 (2%)	0.32 (4%)	3.92 (41%)
Larus dominicanus	163	1.16 (29%)	1.12 (28%)*	0	0	1.72 (43%)*
Larus dominicanus	913	0. 56 (8%)	1.05 (15%)*	0	0.14 (2%)	5.25 (75%)*
Sula leucogaster	251	0.54 (9%)	2.76 (46%)	0	0.24 (4%)	2.46 (41%)*
Sula leucogaster	250	1.125 (15%)	1.05 (14%)*	0.3 (4%)	0.15 (2%)	4.65 (62%)
Sula leucogaster	104	0.36 (4%)	1.53 (17%)*	0.09 (1%)	0.63 (7%)	6.39 (71%)
Sula leucogaster	555	0.6 (15%)	0.68 (17%)*	0	0	2.72 (68%)*
Sula leucogaster	90	1.1 (11%)	2.6 (26%)	0.1 (1%)	0	6.2 (62%)
Sula leucogaster	103	0.35 (10%)	0.84 (24%)*	0	0.035 (1%)	2.275 (65%)*
Sula leucogaster	166	0.7 (5%)	0.7 (5%)*	0.14 (1%)	0	12.46 (89%)*
Sula leucogaster	95	0.385 (7%)*	0.275 (5%)*	0	0.165 (3%)	4.675 (85%)
Sula leucogaster	96	1.05 (15%)	1.26 (18%)*	0	0	4.69 (67%)
Sula leucogaster	259	1.6 (5%)	4.16 (13%)	1.92 (6%)*	0.96 (3%)	23.36 (73%)*
Sula leucogaster	258	0.76(4%)	1.9 (10%)	0.57 (3%)*	0.19 (1%)	15.58 (82%)*
Puffinus	01	0.12 (4%)	1.86 (62%)*	0	0.06 (2%)	0.96 (32%)*
Spheniscus magellanicus	205	1.32 (22%)	0.6 (10%)*	0	0.3 (5%)	3.72 (62%)*
Spheniscus magellanicus	208	0.57 (6%)	1.045 (11%)*	0.19 (2%)	0	7.6 (80%)*
Spheniscus magellanicus	207	0.6 (8%)	0.975 (13%)	0	0	5.925 (79%)*
Spheniscus magellanicus	260	1.47 (14%)	2.625 (25%)*	0.315 (3%)*	0	5.985 (57%)*
Spheniscus magellanicus	204	0.7 (14%)	0.65 (13%)*	0.2 (4%)	0	3.45 (69%)*
Spheniscus magellanicus	209	3.995 (17%)*	3.29 (14%)	0	0	16.215 (69%)

* Values below or above reference values

Most of the birds sampled were found to have lymphopenia, including *S. magellanicus*, *S. leucogaster*, *Puffinus*, and *L. dominicanus* (Tables 1,2, and 3).

Discussion

Migratory birds may carry a variety of pathogens. This leads to two troubling situations: (i) the spread of new pathogens to new locations where they were not present before and against which other organisms may not have specific immune defense; and (ii) the possible transmission of these pathogens to humans.[18-20]

Although only opportunistic and commensal microorganisms were found in the present study, the findings are still of great concern. Many authors argue that different species of potential pathogenic bacteria are found on normal skin and in respiratory tracts and digestive tracts of healthy animals, and that these species can cause diseases when the defense barrier is broken.[21,22]

It is important to mention that all of the microorganisms that were isolated in this study can cause serious health problems for seabirds and have been isolated in several rehabilitation centers as the cause of illness in these animals.[9,23,24]

An infection may develop because of stress in the natural environment during the reproductive season, during the offspring care period, or when there are severe environmental conditions.[25] The stress caused by the birds' experiences in rehabilitation centers may also facilitate bacterial infection.

Newman et al.[26] showed that infectious diseases caused by bacteria, fungi, and viruses are responsible for 20% of bird mortality, of which bacteria causes 38% and fungi 7%. This research also demonstrated that mortality caused by bacteria was much higher in seabirds with coastal habits than in pelagic seabirds. This finding may be associated with human activity in coastal regions. It may also explain both the high density of bacteria found in this study and the presence of genera that are indicators of anthropogenic pollution (*Enterococcus* sp.), since the southeastern coast of São Paulo state has high rates of contamination by domestic sewage.[27]

Enterococcus sp. is not commonly find in the respiratory tract, as this genus mainly inhabits the gastrointestinal tract.[28] However, in this study, the genus was found in 24% of the seabirds analyzed. This finding can be explained by the fact that these birds remain in contact with water and/or sediments contaminated by wastewater, which has high densities of *Enterococcus* sp.[29] This result is concerning, because some groups of *Enterococcus* sp. affect organs outside the digestive tract and can cause necrotic inflammation.[30]

Hubalek[18] made a checklist of pathogens carried by migratory birds, most of which were found in the present study. The checklist includes *Staphylococcus* sp., *Candida albicans*, *Aspergillus* sp., *Salmonella* sp., *Clostridium* sp., and *Enterococcus* sp.

The prevalence of the microorganisms isolated was very similar to the values reported by Zampieri et al.,[31] who analyzed the same region in a different period.

The fact that *Staphylococcus* sp. was most prevalent in all seabird species evaluated in this study may be associated with the high densities and the resistance of *Staphylococcus* sp. (especially *S. aureus*) observed in polluted seawater samples.[32] This factor is extremely important, because polluted coastal waters can go on to contaminate marine organisms, including birds and can thus be a focal point for *Staphylococcus* sp. dissemination, particularly by migratory birds and other seabirds.

Salmonella sp. was found to have a relatively low prevalence in seabirds compared to the other bacteria found in this research. Many studies[24] have reported that some seabirds are important vectors of these bacteria. The low prevalence of *Salmonella* sp. in this study may be explained by the fact that the specific methods required to isolate this genus were not applied.

Most of the species of bacteria isolated are opportunist pathogens, and the blood parameters reveal some associations with bacterial infections. Fifteen of the 25 seabirds were found to have a low cell volume, a finding which is indicative of anemia. According to Capitelli and Crosta,[33] the main causes of anemia in birds are parasitic infections, bacterial infections, chronic diseases, and nutritional deficiencies. The results of these analyses seem to be consistent with the blood parameter values.

Most of the seabirds analyzed were found to have leukopenia. Leukopenia commonly results from heteropenia and is associated with septicemic infections, nutritional disorders, anaphylaxis, radiation, and autoimmune reactions. A decrease in heterophil numbers can be seen with the increased use of cells, as in the fight against infections by microorganisms. In general, heteropenia has been associated with serious and, consequently, poor prognoses.[33]

Lymphopenia may be caused by acute systemic infection or by severe stress, which leads to an excess of corticosteroids.[34]

A significant amount of seabirds were found to have leukocytes above the reference values. Leukocytosis in wildlife is often associated with stress, but acute infectious processes, particularly those of bacterial origin, are usually accompanied by an increase in heterophils.[35] Heterophils are equivalent to mammalian neutrophils. They actively participate in inflammatory lesions and are phagocytes; their granules contain the lysozymes and proteins necessary for bactericidal activity. Avian heterophils are involved in the control of bacterial, viral, and parasitic infections.[34]

Three boobies and three gulls were found to have leukocytosis; this finding may indicate that fungi and bacteria are having an impact on the respiratory tract and thus affecting the birds' health. This finding is also consistent with heterophilia (the increase in the number of heterophils) in most birds with leukocytosis (Tables 3 and 4).

It is worth mentioning that one of the birds, which had the most severe cases of leukocytosis and heterophilia (Gull 318; Table 4), was also found to have *Clostridium* sp. in its respiratory tract. This bacterium releases potent toxins that can cause serious infections. During its reproduction process, this bacterium releases potent toxins that can cause serious infections. It deserves special attention because these infections generate high morbidity and mortality rates, particularly in aquatic birds.[28] Therefore, a previous diagnosis of this bacterium can avoid severe complications in seabirds during the rehabilitation process.

Fungal infections in birds are among the most common and serious systemic diseases,[36] and members of the genera *Aspergillus* sp. and *Candida* sp. are the most frequently isolated pathogens.[18,25] Our findings were consistent with these assertions.

A large number of studies[37-39] have shown the severity of aspergillosis, which causes high mortality rates in penguins. In the current study, three of the five penguins with *Aspergillus* died, and the necropsies confirmed aspergillosis. This finding represents the importance of a previous diagnosis for birds' successful reintroduction in nature.

According to the literature, the blood tests from the birds with aspergillosis revealed leukocytosis with heterophilia at an early stage, mononucleosis with toxic heterophile at later stages of the

Kelp gull (*Larus dominicanus*).

fungus[40] (Tables 3 and 4).

Nevertheless, it should be emphasized that the absence of specific reference ranges for blood parameters can alter the results, since bird blood samples can be influenced by nutritional status, sex, age, habitat, season, reproductive status, trauma, creation, and environmental stress.[35,42] Therefore, information on these variables must be considered when evaluating blood parameters in birds, but this information is limited and many studies are still needed in this area.

Trichophyton sp. was present in only 12% of the birds in the current study. This fungus is associated with skin diseases, especially in chickens,[43] but there are no studies that have reported its presence in seabirds. *Penicillium* sp. was found in only two animals. Garcia[36] also found fungi in the tracheas of wild birds. The author reports that this genus is common in birds and that, in the study, 30% of the birds were found to have *Penicillium* sp. in their respiratory tracts. Nevertheless, few studies have asserted that *Penicillium* sp. can develop into a disease in birds.[44] Therefore, it is unlikely *Trichophyton* sp. and *Penicillium* sp. are causing the diseases reflected in the blood parameters in this study.

However, microorganisms isolated from seabirds can cause serious problems in humans as well. An example is *Candida albicans*, which may cause severe and even fatal infections and which presents as lesions and eruptions on the skin, nails, mouth, bronchial tubes, and lungs. There are suggestions that certain strains of this species are pathogenic.[45] It is important to mention that *Candida* sp. was the most commonly isolated fungi in the seabirds in the current study.

This finding reaffirms the importance of monitoring these diseases, as *Larus dominicanus* and *Sula leucogaster* usually mix with humans in recreational settings and, as migratory birds, can be important vectors and disseminators.

The blood parameters in this study revealed the occurrence of bacterial and fungal infections in Brazilian seabirds. Additionally, fungi appeared to affect the blood parameters more than bacteria did, even though bacteria make up most of these animals' commensal organisms.

Many studies are still needed in this area, particularly to establish reference values for each species of bird that frequents the Brazilian coast. These reference values will make it easier to identify diseases and other problems that affect birds both before

disease, and lymphopenia.[37,39,40] Only two of the seabirds tested were found to have *Aspergillus* sp.: *Larus dominicanus* 318 and *Sula leucogaster* 104. Only *Larus dominicanus* was found to have leukocytosis and heterophilia, but it is important to note that *Sula leucogaster* was found to have lymphopenia. These factors are very telling: Aspergillosis is a disease that causes higher mortality rates in seabirds, especially in certain species of penguins.[38] In addition, these birds showed serious problems resulting from aspergillosis, while two *Spheniscus magellanicus* died during the study period.

This difference suggests that *Aspergillus* sp. appears to develop into more severe diseases and to generate higher mortality rates in species that frequent the coast less often or have less contact with humans and the pathogens common to coast region pathogens, such as *Spheniscus magellanicus*. Burco et al.[41] show this higher vulnerability in seabirds in captivity than in seabirds in the wild that do not have contact with *Aspergillus* sp.

Like other migratory birds, *Spheniscus magellanicus* may have contact and be infected by various pathogens during their migrations, as was observed in this study in the cases of *Enterococcus* sp and *Aspergillus* sp. The birds may then spread the pathogens to other animals who had never exposed. Thus, the pathogens are able to cause serious increases in morbidity and mortality rates.[38]

In the current study, 36% of the seabirds were found to have *Candida*. This fungus is typically an opportunistic pathogen that infects birds when they already have primary infections or bad nutrition.[36] Our results, therefore, were remarkable: *Candida* was the most commonly isolated fungus among the animals analyzed.

Birds that were found to have *Candida* sp. in their respiratory tract showed signs of infectious processes (birds 914, 318, 319, 259, and 166). The analyses revealed high levels of leukocytes and heterophilia, which may indicate infection by this type of and during the rehabilitation process. Nevertheless, our study offers some information on blood parameters and on the changes that birds experience during the rehabilitation process. Our tests revealed that some seabird species are more sensitive to certain microorganisms. With effective treatment and rehabilitation, success in relocating species to their natural habitats will be achieved.

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Mapping patient intake: A geospatial analysis of admitted wildlife rehabilitation patients

Molly C. Simonis, Rebecca A. Crow, Debra K. Oexmann

Trillium Tail at Bruckner Nature Center, Troy, Ohio.

ABSTRACT: Wildlife research is very important to the rehabilitation community, especially post-release studies. However, to begin to examine post-release, we must first understand where our patients are geographically in order to recognize where potential conflicts might arise. This paper presents an analysis of patient intake at Brukner Nature Center's Wildlife Rehabilitation Unit from 2006–2013. Initial patient location was mapped using Geographic Information System (GIS) technology provided through a student license for ESRI's ArcMap10.2. Results show the majority of wildlife patients were found in urban areas surrounding the center. This study provides Brukner Nature Center with baseline rehabilitation research for future admit, release, managerial, and potential collaborative studies in the future.

KEYWORDS: wildlife, wildlife rehabilitation, GIS, human-wildlife interaction, Brukner Nature Center, geospatial analysis, urban wildlife, wildlife conservation

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Introduction

Brukner Nature Center (BNC) is a privately-funded, nonprofit organization dedicated to promoting the appreciation and understanding of wildlife conservation through education, preservation, and rehabilitation. Located in Troy, Ohio, BNC opened to the public in May of 1974 by way of local philanthropist Clayton J. Brukner. The 235 acres of Ohio native habitats surround an interpretive building that houses interactive displays, a tree-top bird vista, and more than 50 permanently injured wildlife ambassadors. BNC offers a wide variety of educational, wildlife-oriented programs and events to the public, extending their mission beyond the grounds.

BNC also operates as the largest licensed wildlife rehabilitation facility in southwest Ohio. The purpose of BNC's Wildlife Rehabilitation Unit is to educate people regarding the natural history of Ohio's wildlife, to offer help and advice when wildlife and people conflict, and to care for, rehabilitate, and release native Ohio wildlife expected to survive in the natural environment. On average, one thousand animals are brought in

J. Wildlife Rehab. 35(3):21-27.

by caring individuals from about 20 Ohio counties each year. As a nonprofit organization with limited time and resources, BNC focuses on species it can best care for and networks with other wildlife organizations to find help for those they cannot help. As a larger patient intake unit, the daily care for all rehabilitation animals is provided by staff and volunteers and is coordinated by BNC's Curator of Wildlife.

The rehabilitation unit follows Minimum Standards for Wildlife Rehabilitators in Ohio[1] as well as an invasive non-native species policy outlined by the Ohio Department of Natural Resources (ODNR) Division of Wildlife (ODW) (ODNR, 2014). Standards also include recommendations from the National Wildlife Rehabilitation Association (NWRA), the International Wildlife Rehabilitation Council (IWRC), and the Ohio Wildlife Rehabilitators' Association (OWRA) for nutritional, record keeping, and facility requirements. Permit requirements are fulfilled annually in year-end reports to US Fish and Wildlife Service (USFWS) for avian species and to ODNR for mammalian, reptilian, and amphibian species.

Veterinary standards are provided by Troy Animal Hospital and Bird Clinic of Troy, Ohio. Owner Dr. Lonnie L. Davis, DVM, ABVP, and associate veterinarian Dr. Julie Peterson, DVM, provide diagnostics, treatment, and recommendations for the medical treatment of BNC's rehabilitation patients.

Geographic Information System (GIS) technologies are computer program systems used for locating and examining various types of geographic data. The software provides users with the ability to analyze and interpret data through mapping. GIS is helpful for solving problems and answering questions by looking at data with geographically referenced information. GIS allows for trend, pattern, and relationship identification in a way that is quickly understood through visual representation.[2]

Geospatial representation studies of wildlife patients are limited in the rehabilitation field. Wildlife rehabilitators help to play a key role in conservation, and GIS technologies can help to illustrate their efforts. GIS is currently being widely used across a diverse range of preservation studies: loggerhead turtle hotspot mapping,[3] plotting mollusk assemblages in Poland,[4] mapping Brazilian coral reef habitat,[5] and black bear priority area identification in Texas,[6] to mention a few. This technology can be used on a broader scale as this study will demonstrate, or on a fine scale such as that used for endangered species habitat model studies.[7] With its many potential capabilities, GIS can be a useful tool in a rehabilitator's data analysis.

This study uses GIS technologies to give spatial reference to patient intake information and helps to visualize where wildlife patients are originating. It also represents areas that have been influenced by BNC's rehabilitators, who provide education on the natural history of native Ohio wildlife to every animal donor and wildlife caller. This baseline information can pave the way for many other research opportunities within BNC's organization, as well as collaborative projects.

The purpose of this study is to determine where admitted orphaned and injured wildlife is originating in relation to BNC's Wildlife Rehabilitation Unit. The study uses patient information between the years of 2006 and 2013 to reach a conclusion.

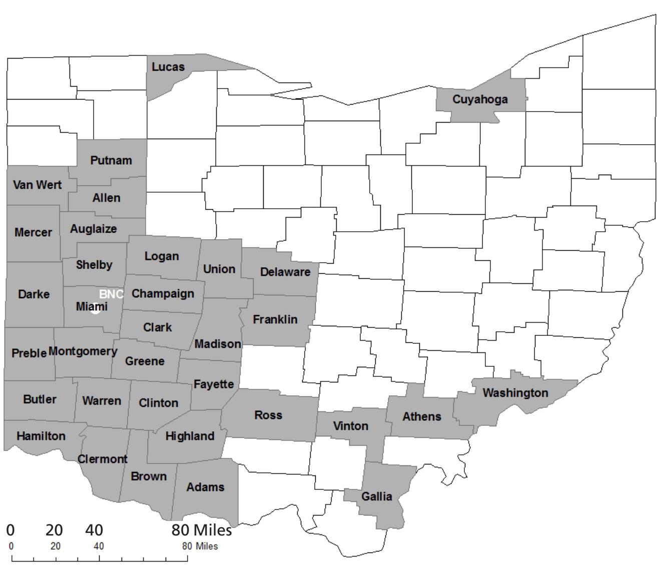


FIGURE 1. Ohio counties where BNC's Wildlife Rehabilitation Unit's patients have originated from the years of 2006–2013.

Methods

For each patient admitted to BNC's Wildlife Rehabilitation Unit, a Wild Patient Donor Form is filled out by the animal donor. These forms collect location information including the donor's home address and county where the patient was found. If an animal is not found at the donor's address, more detailed information on where the patient was found can be provided in the History/Nature of Injury section of the form.

From that donor form, each patient is assigned a case number. Numbers are assigned from #1 on January 1 of each year and continue through December 31. Patient case numbers are repeated each year. All case information was recorded by a BNC staff member or volunteer into an annual Microsoft® Excel workbook. In addition to donor provided information, patient disposition was recorded in the file as well.

Each annual workbook from 2006–2013 was then cleaned to eliminate data not of interest for this study (i.e., donor phone number, donations, and comments). Each patient entry was assigned a unique identification number and organized by county and intake year. The data was counted and recorded to show the admitted number of animals from each county annually for 2006–2013 (Table 1). This table was imported into ESRI's ArcMap 10.2 and combined with Ohio county shapefiles by county name in a process called joining. The Ohio county shapefiles were created through a selection process within the program using the US Census Bureau's Topologically Integrated Geographic Encoding and Referencing (TIGER) files from the 2010 census survey. In the US County shapefile, only counties within the state of Ohio were selected and then saved as its own shapefile. Fig. 1 was created by displaying counties where rehabilitation patients

FIGURE 2. The number of patients admitted into BNC's Wildlife Rehabilitation Unit in relation to their counties of origin. Every wildlife admittance county active at least once from 2006–2013 is represented.

originated within the years 2006–2013. Fig. 2 was created by displaying the number of patients admitted each year from these counties between 2006 and 2013. Counties with darker gray shades indicate larger intake numbers.

Annual Excel workbooks were then exported to a Microsoft® Access database and uploaded to Texas A&M (TAMU) GeoServices to obtain latitude and longitude data because ESRI's geocoding service is not provided on a student license. Geocoding is a process used to obtain a geographic coordinates from, in this instance, a street address. Once geocoded, the Microsoft® Access databases were exported into Excel and brought into ArcMap 10.2 for visualization and analysis. Fig. 3 displays all address points where wildlife patients originated within the eight years covered by this study. If more than one patient was admitted from the same address (i.e., mammalian litters, avian clutches, etc.), it was represented by a single geographic coordinate. For example, if five neonate eastern cottontails were admitted from Donor A's back yard due to a predator attack, the five cottontails are represented by one geographic point in Figs. 3 and 4. The number of patients admitted are held as an attribute in the joined table as representation, but not displayed. Fig. 4 then provides a closer view of where the majority of patients originated from with an Urban Areas layer and displayed as a transparent overlay. The Urban Areas layer was created from 2010 US Census Bureau's TIGER files, selected for the state of Ohio only, and saved as its own shapefile.

Results

Through Table 1 and Fig. 1, it is shown that BNC's Wildlife Rehabilitation Unit has touched 34 of 88 Ohio counties in an eight year period. Fig. 2 indicates most of BNC wildlife patients are originating from Montgomery County, with BNC's home county of Miami taking second rank. Other counties of larger intake origins are Clark, Darke, and Greene. A large cluster of intake patient points are displayed in Fig. 3 within Montgomery County and Miami County, supporting the previous annual county findings in Fig. 2. Lastly, Fig. 4 gives a visual relationship between wildlife patients and urban areas. Zoomed in, one can see patients originating in and around the Dayton, Ohio, vicinity, thus displaying the majority of wildlife patients facing conflicts in the same urban area.

Discussion

This study predominantly presents spatial trends in the Ohio counties with a greater number of wildlife admittance patients within a 50-mile radius of BNC's property. However, results also display outlier patients in counties where few patients have originated from 2006–2013. These outliers are related to two patient scenarios: 1) patients were transferred from other rehabilitation facilities, and 2) patients were removed from their origin by the patient donor without knowledge of other rehabilitators at a closer distance to where the patient was discovered. Even though these anomalies are accounted for, they are rare and do not overly skew data trends.

Other limitations of this study can be attributed to human error. The total number of patients admitted each year when totaled in Table 1 did not exactly match numbers in annual permit reports. It was often found the patient's Wild Patient Donor Form was not complete. Other circumstances reveal that data entry by staff and volunteers was incomplete or lacked standardization. Although missing intake numbers each year varied from two to 21 patients, the trends identified in this study were not affected. While fewer than 1% of patients were unidentified, 99.2% of total patient intake is represented throughout this study giving 7,919 of 7,980 total patients a geographic location.

As a baseline analysis, this study can encourage many other collaborative research projects for BNC. These future projects could be conducted by BNC, or outside sources and organizations such as ODNR. Patient admittance origins from this study could benefit many state conservation studies currently in practice like those previously modeled for habitat planning[8] and wildlife action plans.[9] For example, with the species information connected to the geographic location of each patient, these maps and data could contribute by helping to delineate specific species ranges and the habitats in which they reside.

Although patient admittance information is what is investigated in this paper, all other attributes of donor information and patient disposition are attached to each point displayed in Figs. 3 and 4. Further study and research collaborations could use similar maps with different attributes explored. For example, displaying characteristics such as animal type and/or species could help with small and large scale biodiversity studies like those modeled in the southwestern US.[10] Presenting geospatial analyses of patients' injury or admittance reason could benefit wildlife disease research similar to studies of West Nile Virus in squirrels.[11] Furthermore, as this study implies a relationship between rehabilitation and human-wildlife interaction in more urbanized areas, showing these values paired with dispositions could contribute to public health studies and recommendations.[12] Lastly, these attributes could support studies that exhibit trends associated with urbanization and wildlife causes of death.[13] Any of these prospective research directions would be beneficial across multiple fields of interest when collaborated.[14]

Not only do the findings in this paper illustrate where wildlife patients are originating, but the results could also be interpreted as the extent of BNC's educational outreach. It is the mission of BNC's Rehabilitation Unit "to educate people regarding the natural history of Ohio's wildlife," and "to offer help and advice when wildlife and people conflict." During patient admittance, staff members educate the public, and it has been shown previously that facilities similar to BNC contribute greatly to the dissemination of information about wildlife, biodiversity, and environmental sciences.[15,16] Further study for this interpretation might indicate how BNC's outreach has educated the public, or changed perceptions of wildlife,[17] wildlife conservation,[18] and the resources available to help.[19]

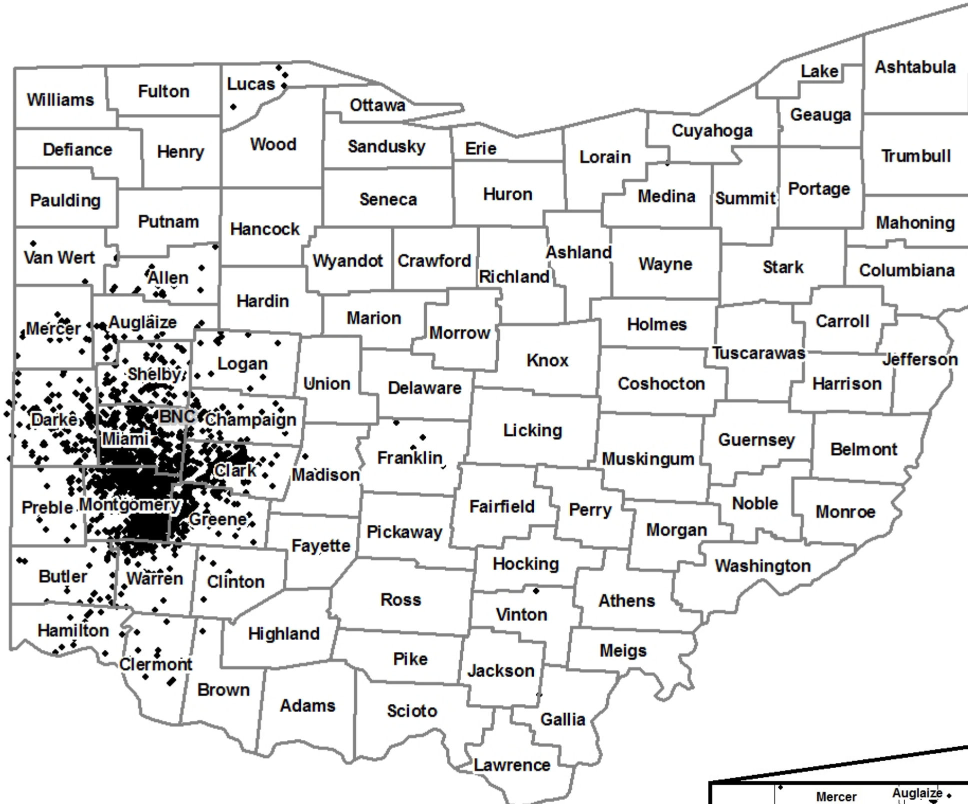
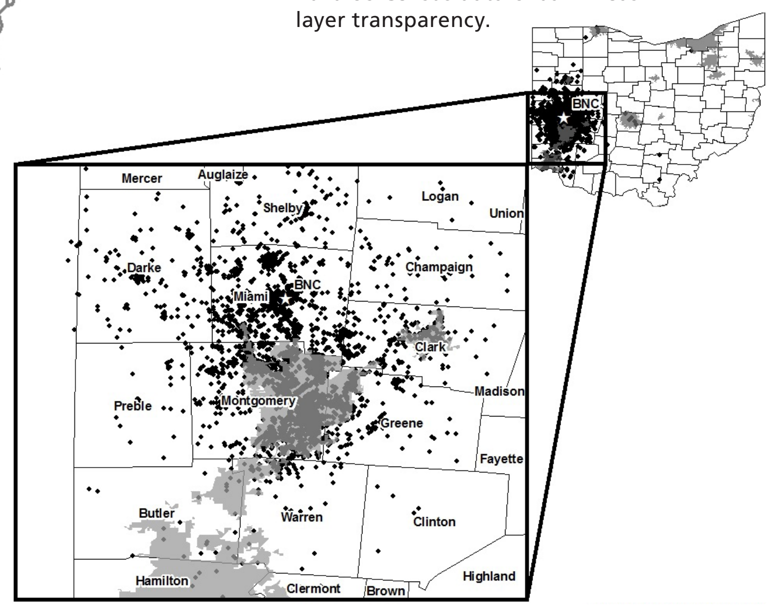


FIGURE 3. Geocoded addresses where patients were found based on patient donor forms from 2006–2013. Geocoding services were provided through Texas A&M University GeoServices.

FIGURE 4. Geocoded patient addresses from 2006–2013 with a 2010 US Census data Urban Areas layer transparency.



Conclusion

Orphaned and injured wildlife being accepted in BNC's Wildlife Rehabilitation Unit each year is originating from the more urbanized areas near BNC. In particular, the largest number of animals being admitted each year is coming from the more developed areas in Ohio's Montgomery County. Seeing these attributes mapped through GIS software supports the mission of BNC's Rehabilitation Unit.

Acknowledgments

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About the Authors

Molly C. Simonis graduated from the University of Dayton with a BS in Environmental Biology in 2009. After an internship with Brukner Nature Center in college, she pursued professions in the veterinary field before returning as their Wildlife Research Fellow in 2014. Molly continues to pursue further education in conservation and GIS technologies.

Rebecca A. Crow graduated from the University of Toledo with a BA in Environmental Sciences in 2004. In 2005, she joined Brukner Nature Center where she is currently employed as the Curator of Wildlife. In addition, Rebecca has been affiliated with the Ohio Wildlife Rehabilitators' Association since 2007 and currently serves their Board of Trustees as President.

Debra K. Oexmann graduated from Miami University of Ohio with a BS in Zoology and a Masters in Environmental Sciences. She is currently the Executive Director of Brukner Nature Center where she has worked for the past 25 years.

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TABLE 1. THE ADMITTED NUMBER OF ANIMALS FROM EACH COUNTY ANNUALLY FOR 2006–2013.

COUNTY	INTAKE 2006	INTAKE 2007	INTAKE 2008	INTAKE 2009	INTAKE 2010	INTAKE 2011	INTAKE 2012	INTAKE 2013	TOTAL INTAKE
Adams	0	0	0	0	0	2	0	0	2
Allen	5	8	6	2	2	2	9	6	40
Athens	0	0	0	0	0	1	0	0	1
Auglaize	9	6	6	8	3	8	4	15	59
Brown	0	0	1	1	0	0	0	1	3
Butler	1	2	2	3	17	0	7	3	35
Champaign	5	7	6	14	28	5	25	15	105
Clark	76	47	81	47	76	69	66	48	510
Clermont	0	0	0	2	0	4	6	11	23
Clinton	2	0	1	1	0	0	9	2	15
Cuyahoga	0	0	0	0	0	0	1	0	1
Darke	37	32	45	39	79	39	44	54	369
Delaware	0	0	0	0	1	0	0	0	1
Fayette	3	0	0	0	0	0	1	0	4
Franklin	0	1	0	0	6	13	0	5	25
Gallia	0	0	0	1	0	0	0	0	1
Greene	73	51	89	47	86	86	83	81	596
Hamilton	7	1	1	1	6	9	3	3	31
Highland	0	0	0	0	0	3	0	1	4
Logan	2	8	2	1	1	3	2	1	20
Lucas	0	0	0	0	0	4	0	0	4
Madison	0	0	7	0	0	0	0	0	7
Mercer	5	2	1	4	3	4	7	13	39
Miami	331	258	322	304	257	272	297	316	2357
Montgomery	406	404	361	411	410	395	399	430	3216
Preble	5	12	5	12	6	11	16	10	77
Putnam	1	0	0	0	0	0	0	0	1
Ross	0	1	0	0	0	0	0	0	1
Shelby	27	32	42	45	26	14	30	27	243
Union	1	0	1	0	0	0	0	0	2
Van Wert	0	1	0	0	0	0	0	2	3
Vinton	0	0	0	0	0	1	0	0	1
Warren	15	12	19	10	14	25	12	15	122
Washington	0	0	0	0	0	0	0	1	1
Totals Intake	**1011**	**885**	**998**	**953**	**1021**	**970**	**1021**	**1060**	**7919**
Total Counties	**19**	**18**	**19**	**19**	**17**	**21**	**18**	**22**	**34**

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IWRC

Education and Resources for Wildlife Conservation Worldwide

Lead Poisoning Position Statement

Lead poisoning is a cause of wildlife suffering around the world, a fact well supported with radiological and laboratory data in North America and Europe. Lead sources that are known to impact wildlife and sometimes humans include lead based paints, ammunition, fishing tackle, industrial and building materials, petrochemicals, and even lead contaminated drinking water and food. This position statement has been prepared to specifically address the incidence of toxicosis associated with the ingestion of lead based ammunition and fishing tackle. Over 500 peer-reviewed papers demonstrate the deleterious effects of lead on wildlife.[1] Lead has been recognized as toxic to wildlife for over a century; and even sublethal levels may cause immunological and neurological problems, biochemical and behavioral changes, and physiological disorders that may affect immune response and reproduction.[2] The chronic stage may be characterized by gastrointestinal stasis, and cause anemia, liver, kidney, and nervous system dysfunction.

Wildlife rehabilitation patients prompted research into secondary poisoning in birds of prey in the 1980s and 1990s.[3] Since then, several rehabilitation centers have reported lead poisoning as one important cause of individual ingress to their facilities.

IWRC POLICY

- IWRC supports the elimination of lead released into the environment through the discharge of lead-based ammunition and fishing tackle, in order to safeguard wildlife, ecosystems, and human health. This objective should be achieved based on education, improving access to lead-free ammunition, and appropriate legislation.
- IWRC supports the use of non-toxic ammunition such as copper bullets and steel shot.
- IWRC supports the use of non-lead fishing tackle such as tin, steel, and tungsten.
- Wildlife patients (carnivorous species under care) should not be fed animals suspected to be injured or killed with lead ammunition unless carcasses are subjected to radiological examination.
- Animals shot with lead ammunition should be disposed of via incineration or burial to depth safe from scavengers in the local ecosystem.
- As an international council, we strongly recommend the development of research from countries with insufficient baseline data, with the aim of obtaining scientific-based support for limiting the global use of lead ammunition and fishing tackle in all countries.

Context: *Background and Scientific Support for Position*

Lead is toxic to living organisms. There is no safe level of lead exposure for humans[4,5] or wildlife.[2] Studies have found that more than 130 species, including mammals, birds, reptiles, amphibians, and fish, are affected by lead toxicity.[1,6–8] Lead ammunition is banned completely in Denmark, the Netherlands, and Sweden and in waterfowl hunting specifically in 14 countries including the US and Canada.[9] Lead fishing tackle is banned completely in Denmark, and some fishing tackle regulations exist in the UK, Canada, and in six US states.[10] Waterfowl mortality due to lead toxicity declined after the implementation of Canadian and US bans on lead shot for wetland gamebirds.[11,12]

Context *(continued)*

Acute lead toxicity causes anemia, ataxia, appetite loss, and behavioral changes, often resulting in sudden death.[7] Chronic lead toxicity results in gastrointestinal stasis[13] and causes anemia, liver, kidney, and nervous system dysfunction.[14] Direct lead exposure happens when animals consume lead objects.[2,15] This is common in gruiformes, galliformes,[2] waterfowl,[15] doves, and loons.[8] Predators experience lead toxicity via indirect exposure, eating the tissues of species that were shot with lead ammunition or which ingested lead fishing tackle.[6,8,15] Lead greatly affects diurnal birds of prey due to high gastric secretions[13] that quickly break down lead in the gut and introduce it to the blood stream and later into the liver, kidneys, and bone.[2] Large, long-lived, slow-breeding, social, obligate scavengers such as condors are particularly at risk of lead toxicity.[2,15]

Remains of game are a primary source of lead for these species, and periods of poisoning intensity occur during and directly after regional hunting seasons.[2,3,14,16] Lead shot and bullets fragment upon impact,[2] with fragments traveling 45cm from the wound tract.[17,18] One-hundred-seventy[3] (170) to over 200[18] lead fragments can remain in a single gut pile.

Use of non-toxic ammunition would remove a primary source of lead exposure to terrestrial species.[2,6] Use of non-toxic ammunition increases annual hunting costs by just 1-2%.[6] Non-toxic ammunition is widely available in North America[6,9] and Europe with market availability expected to grow further with increased regulations on lead ammunition.[19] Contemporary non-toxic ammunition, including but not limited to steel shot, copper bullets, and metallic matrix core bullets, are both accurate and lethal, making them humane hunting alternatives to lead.[20–23]

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Lead Poisoning Position Statement
page 3

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Community cats and native wildlife in the United States

By Deb Teachout, DVM

This column—the third in a series of three exploring the impact of free-roaming cats on native wildlife—delves into the situation in the United States. Previous columns addressed the impact of free-roaming cats in the UK and in New Zealand.

PHOTO © DON BOK/CONCERNED CITIZENS FOR ANIMAL WELFARE.

Well-managed community of cats in Port Orange, Florida.

In the US, if you want to talk controversy, just bring up the subject of free-roaming cats and their impact on native wildlife. It pits the conservationists against the cat lovers, and both sides have their own reputable scientific data to back up their positions. Conservation groups and wildlife enthusiasts say the free-roaming cats kill significant numbers of native birds, small mammals, reptiles, and amphibians, and compete with native predators for prey, while cat advocates say these numbers are distorted and the impact of the killing by cats is really very small compared to other stressors on these native wild populations. Humane organizations and people that identify with both sides have to try to straddle the debate. As can be seen in the previous two articles in this series by Adam Grogan[1] from the UK and Dr. Yolanda van Heezik[2] from New Zealand, this is a worldwide dilemma.

My cousin lives in Indiana and is a cat lover. She has provided a home for many free-roaming and homeless cats over the years. She has brought them in, spayed or neutered them, got them vaccinated, provided veterinary care when they were sick, and they lived long and happy lives, indoors. Three years ago, a small, black, feral, pregnant cat appeared on her porch. She started feeding her with the intent to adopt out the kittens when they were old enough and keep mom cat. But, all four kittens were black and mom cat would not tame down. In spite of help from the local humane society, her veterinarian, and friends, my cousin was unable to place the kittens due to a huge oversupply of kittens already needing homes. In addition, black kittens (just like black dogs) have a harder time being adopted. Mom cat is now spayed and comes to the house for food and shelter every few days. Unable to face euthanizing the kittens just because she couldn't find homes for them, my cousin resignedly added them to her family of four indoor cats but quickly learned having eight indoor cats was not going to work in a small house. Cat wars ensued and her only option was to allow the kittens (by now, six months old, spayed, neutered, and vaccinated) outdoors for the day and indoors at night. One of the kittens was killed by a car early on, but the three remaining kittens are thriving. And even though they get all the food they can eat at home, they kill. Here is what she told me in a recent email, "The 'kittens' are awesome hunters and bring down birds a couple of times a week. Some can be rescued and some not . . . I really hate that the kittens are such good hunters but I see no way to stop them—Mom Cat taught them well."

I asked my cousin what happens when another pregnant cat appears on her porch. She said she would have to ignore it, maybe feed it, but she would not be able to afford to do what she did for her current kittens. Her house is full and she is done. I told this true story because it plays out over and over in big ways and small, not only in the United States but across the entire world. Kind-hearted people and organizations are doing their best, but, wildlife continues to be attacked, to suffer, and to die needlessly. And the cats just keep coming.

Many municipalities in the United States employ trap-neuter-release (TNR) programs to varying levels of success. Due to the social, legal, biologic, and economic issues that must be considered in dealing with the free-ranging cat problems, the TNR programs are the most publicly acceptable compromise as a means of control to the various stakeholders. Terminology for referring to feral and free-ranging cats has softened to "community cats" which reflects the newer ideology of the animal sheltering professionals. They

PHOTO ©DELINDA HOODE.

have found that by leaving and supporting cats in their outdoor neighborhood communities, the numbers of cats entering shelters has plummeted and the number of cats being euthanized has also, therefore, plummeted. This is a good thing as this plan frees up more resources for spaying and neutering. The down side to this new approach is that long-lived cat colonies are convenient public dumping grounds for unwanted cats. The colonies will continue to grow in spite of vigorous TNR policies.

The American Veterinary Medical Association, the Humane Society of the United States, the American Society for the Prevention of Cruelty to Animals, and local animal control agencies urge responsible cat ownership, frequent exams, spaying and neutering, and keeping cats inside for their safety and health. But, these same organizations support TNR programs which, as stated above, provide convenient public dumping grounds for unwanted cats. There seems to be a bit of a mixed message in there, but it also speaks to the complexity of the problem.

Cat statistics for the US:[3]

- There are 74–80 million owned pet cats in the US; 80–85% are sterilized; 30–40% are allowed outdoors.
- There are 30–40 million unowned community cats in the US; 2% are sterilized. This is the target population for reproductive control.
- Divide the human population by 10 for an estimate of community cat population in a given area; numbers vary with human demographics, land usage, climate presence of predators, and availability of resources.
- According to a national survey – What would you do about unowned cats in the street? 81% said leave the cats alone; 14% said trap and kill the cats; 5% had other answers.

Wildlife killed by free-ranging cats annually in the US:[4]

- Estimated 1.4–3.7 billion birds
- 6.9–20.7 billion mammals
- Likely the single greatest source of anthropogenic mortality for US birds and mammals

Managing community cat populations: what doesn't work:[3]

- Trap and remove/relocate/kill
- Feeding bans
- Licensing laws, leash laws, pet permits
- Sanctuaries

Managing community cat populations: what works:[3]

- Targeted trap-neuter-return, especially targeting areas with high concentrations of free-roaming cats
- Immigration (new cats) must be prevented and high (>50%) spay/neuter rates implemented to reduce numbers in free-roaming cat populations.[5]
- Spay/neuter at younger ages
- Low cost spay/neuter
- Medical and behavioral assistance for cat owners to decrease abandonment
- Move cat colonies from sensitive wildlife habitat
- Educate owners to keep cats indoors
- Cat proof fences around sensitive areas
- Mobilize an army of compassionate, dedicated people who care about cats, wildlife, and their communities

As a veterinarian, I have long been frustrated by the endless numbers of cat-attacked cottontails, robins, frogs, and snakes presented to me as well as by the significant numbers of cats who become injured or sick after being allowed to roam outside by their owners.

I do see a glimmer of hope in the statistics that are coming out of the targeted TNR programs. Also promising is the ongoing and highly funded research into multi-year contraceptive injections for free-roaming cats. Conservationists and cat advocates share the same end goal—reduce the outdoor cat populations in a humane and effective manner.

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Deb Teachout is a veterinarian in Illinois, United States, whose practice serves both domestic and wildlife patients. She is a past member of the IWRC Board of Directors, an associate editor for JWR, and a long-time animal advocate.

News

CONTINUED FROM PAGE 6

West Coast of North America, the bloom is laced with some toxic species that have had far-reaching consequences for sea life and regional and local economies.

While algal blooms do occur with regularity across the Pacific Ocean, the size and duration of this year's event, which began in May, has been particularly noteworthy. Scientists can track the spread and amount of large algal blooms with satellites by looking at chlorophyll concentrations at the ocean surface.

With its large size, the bloom has had a large impact on marine life and fisheries up and down the West Coast. According to Alaska Dispatch News in Anchorage, at least nine fin whales were found dead near Kodiak Island, AK, in June, potentially related to the algal bloom, although definitive proof that the deaths were caused by toxic algae will be difficult to obtain. In July, the Aleutian Pribilof Islands Association received reports of dead and dying whales, gulls, and forage fish in Alaska's Aleutian Islands, with samples being solicited to test for algal toxins.

Over the past several months, extremely high levels of an algal toxin called domoic acid, which is produced by a group of phytoplankton called *Pseudo-nitzschia*, have led to closures of seafood harvests and fisheries up and down the west coast of North America.

According to a press release from the Monterey Bay Aquarium Research Institute, "During a normal *Pseudo-nitzschia* bloom, domoic-acid concentrations of 1,000 nanograms per liter would be considered high. However, by mid May concentrations in Monterey Bay reached 10 to 30 times this level."

With so much at stake for marine wildlife and the economies that rely on it, NOAA scientists are continuing to monitor the bloom along the entire West Coast as it continues to persist and adversely impact a number of fisheries. In the meantime, Climate.gov will talk to NOAA and affiliated scientists about what climate and other environmental factors could be behind this year's extreme bloom. (Courtesy Tom di Liberto, Climate.gov)

Looking at the Tumors: New directions in understanding threat to Tasmanian devils

Hobart, Tasmania, AU (September 2)—New research has found that the tumors of the Devil Facial Tumor Disease (DFTD) at a population in northwestern Tasmania have been changing and competing over the years to increase infection rates. The findings published in the journal Proceedings B indicate that future research efforts to fight the DFTD decimating the Tasmanian Devil population will need to focus on the tumor and its ability to change, as well as on the devils and their genetics.

Lead author Dr Rodrigo Hamede, University of Tasmania School of Biological Sciences, said this research is the first solid evidence that tumor lineages are competing and having an effect on transmission and population effects.

Dr. Hamede said previous research (three years ago) found that the devil population the team was regularly sampling had not declined, the disease prevalence was very low, and animals were surviving for quite a long time and dying from old age, not from DFTD. So the team was very keen on finding out what was happening.

In the years following this, the team found that the tumor strain had changed again, becoming diploid, a more normal and stable tumor carrier type. That coincided sharply with a large and rapid population decline, higher infection rates and devils dying younger.

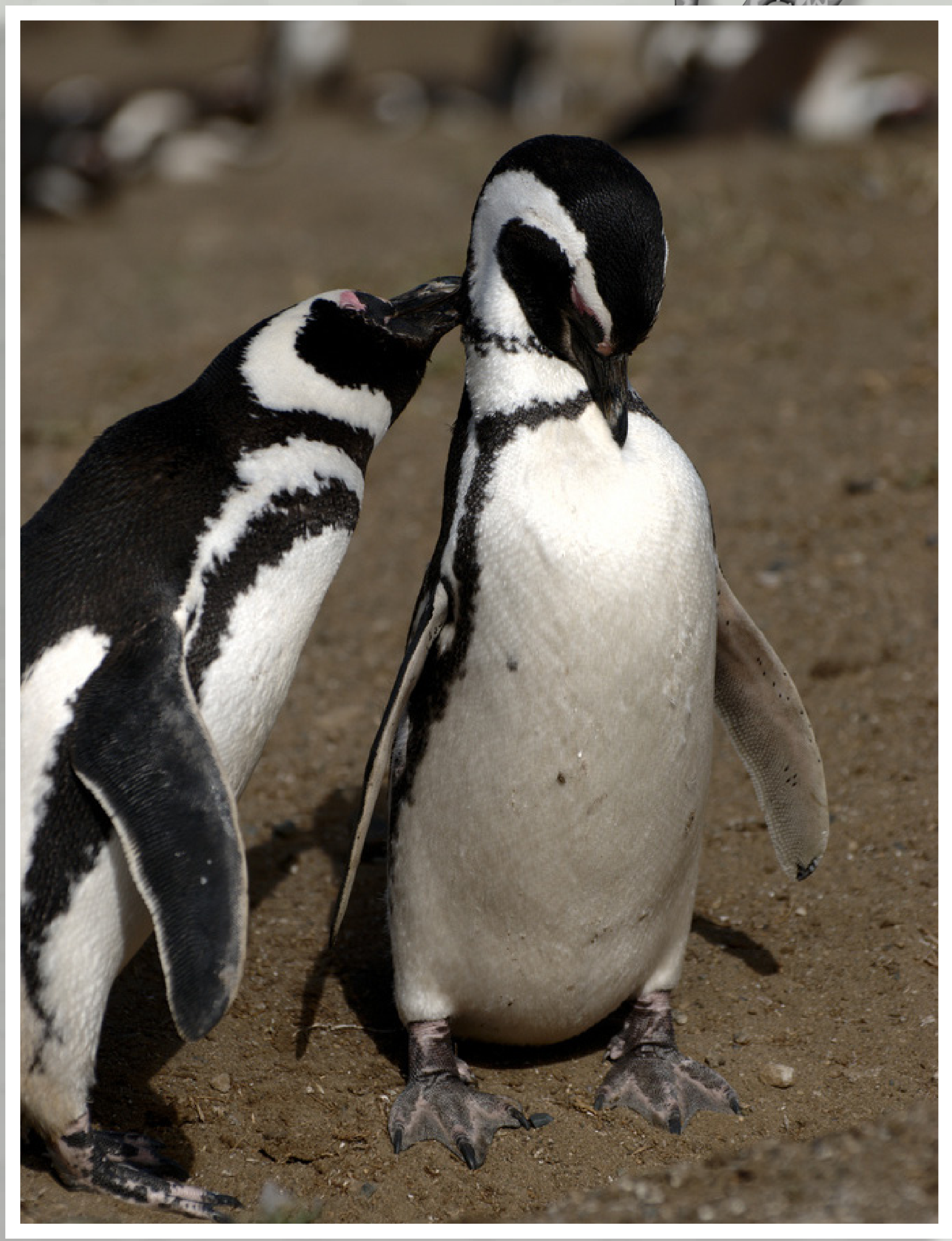
Tasmanian devil *(Sarcophilus harrisii).*

UN General Assembly passes wildlife trade resolution

Geneva/New York (July 30)—Concerned over the serious nature and the increasing scale of poaching and illegal trade in wildlife and its adverse economic, social, and environmental impacts, and expressing particular concern over the steady rise in the level of rhino poaching and alarmingly high levels of killings of elephants in Africa, the United Nations General Assembly (UNGA) unanimously adopted today a resolution on "Tackling Illicit Trafficking in Wildlife."

The UNGA Resolution expresses concern that illicit trafficking in protected species of wild fauna and flora is in some cases an increasingly sophisticated form of transnational organized crime that poses a threat to health and safety, security, good governance, and the sustainable development of states. ■

TAIL END



Let me help you with the zipper, dear.

Magellanic penguins (*Spheniscus magellanicus*).

INSTRUCTIONS FOR AUTHORS

POLICY Original manuscripts on a variety of wildlife rehabilitation topics (e.g., husbandry and veterinary medicine) are welcomed. Manuscripts that address related topics such as facility administration, public relations, law, and education are invited as well.

Associate editors and anonymous reviewers, appropriate to the subject matter, evaluate each submitted manuscript. Concurrent submission to other peer-reviewed journals will preclude publication in the *Journal of Wildlife Rehabilitation* (JWR). The International Wildlife Rehabilitation Council (IWRC) retains copyright on all original articles published in the JWR but, upon request, will grant permission to reprint articles with credit given to the IWRC–JWR.

SUBMISSIONS All submissions should be accompanied by a cover letter stating the intent of the author(s) to submit the manuscript exclusively for publication in the JWR. Electronic submissions are required; hard-copy manuscripts are not accepted. The manuscript file should be attached to the submission letter (which can be the body of your email) and sent to:

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MANUSCRIPT Manuscripts should be MS Word documents in either PC or MAC platform (*no PDF files*).

Manuscript should be typed in Times Roman, 12 pt., double-spaced throughout with one-inch margins.

Include the name of each author. Specify the corresponding author and provide affiliation, complete mailing address, and email address. The affiliation for all authors should be included in a brief (maximum of 100 words) biography for each that reflects professional experience related to rehabilitation or to the manuscript subject matter rather than personal information. Biographies may be edited due to space limitations.

Include an abstract that does not exceed 175 words and choose several (up to 14) key words.

Templates have been developed for the following submission categories: case study, technique (including diets), research, and literature review; authors may request a copy of one, or all, of these templates from the editor (jwr.editor@theiwrc.org) before developing a manuscript for submission to the JWR.

STYLE The JWR follows the Scientific Style and Format of the CSE Manual for Authors, Editors, and Publishers, 8th Edition. The complete "JWR Author Instructions" document is available at:

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A rehabilitator handfeeding a young cottontail rabbit *(Sylvilagus floridanus)* at the Toronto Wildlife Center.

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