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# JOURNAL OF WILDLIFE REHABILITATION

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## 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:
**Barn owl *(Tyto alba).***
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Left:
**Moose calf (*Aces aces*).**
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# JOURNAL OF WILDLIFE REHABILITATION

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## DEPARTMENTS

EDITORIAL

# The Shiny Coat Test

All across North America, the marathon of baby season is beginning. Actually, in the southern regions where tree squirrels begin producing the new year's crop of babies shortly after New Year's Eve, caregivers left the starting gate months ago and are already scanning the road ahead for a relief station and helping hands bearing snacks and Gatorade.

No serious long-distance runner would think of starting a race without first considering where to refuel, when to ease up and recover, and how to maintain a sustainable pace. Wildlife rehabilitators, on the other hand, regularly dash out of the gate at breakneck speed and then try to sprint all the way to the finish line. And frequently, they hit the wall in a year or two; marriages, friendships, finances, and good health piled along the side of their life-road like so many discarded water bottles and orange peels.

How is it that an activity that can provide a sense of purpose, accomplishment, and even great joy to our lives also has the potential to burn out of control, leaving us spent as a pile of ashes? Follow your bliss—sounds like wise counsel, but the sages fail to mention that passion and temperance are not natural companions. When you love and believe in what you do there's a tendency to *over* do.

Unlike caring for a human infant, elderly parent, or an injured spouse, the job of caring for wildlife is a revolving door that never stops turning and a burnout prescription for anyone prone to overcommit. After all, lives are at stake. Is it any wonder so many practitioners fall into the classic caregiver's trap?

Rehab practice is prone to a culture of "martyrdom one-upmanship." Sooner or later the conversation devolves into a competition over who is surviving on the least amount of sleep, or has the largest pile of dirty laundry or empty pizza delivery boxes. Evidence of self-neglect is worn like a badge of honor, a sign of one's commitment to the task at hand.

One day I was teaching new volunteers how to do an intake exam. I suddenly understood that if I were to evaluate my own condition, I would not pass the "shiny coat" test. There's a reason why matted fur and soiled feathers tip us off to other problems—healthy animals spend a lot of time on self-care activities. Even harried wild parents take time to rest, to eat, to preen.

That realization got me thinking about human health care. How willing am I to trust my own well being to a practitioner who doesn't have the shiny coat of someone who gets enough rest, eats a healthy diet, exercises, and enjoys life? Rehab patients don't have any say over who takes care of them, but that shouldn't let us off the hook.

To be the best possible care provider, you must be a care receiver *first*. You make better decisions when fully rested. You have more energy when you eat well and exercise. To do the most good for the longest possible time, it's important to realize that rehabilitation, by its very nature, favors stamina over speed.

All the more reason to make a plan and a commitment to yourself now, before you're up to your ass in alligators (maybe literally!), to care for yourself at least as well as you care for your wild patients. Instead of trading stories about sleepless nights, share tips for living well while doing good. Change the tone of the conversation from commiseration to empowerment. Map out those relief stations so you have the best possible chance of making it to the finish line in one piece, anxious to begin the next year's race.

**Kieran Lindsey**
*Editor*

*[NOTE: They say you teach what you most need to learn. I wrote this editorial at 10 p.m. on my birthday. Some lessons are harder to learn than others.]*


PHOTO © TRACY COLSON, USF&W HEADQUARTERS. CREATIVE COMMONS.

Endangered Florida manatee *(Trichechus manatus).*

### Manatee Leaves Columbus Zoo for New Home

*POWELL, Ohio, USA (January 14, 2013)*—A manatee's road to recovery ended in Cincinnati this weekend. Woodstock was found in late 2011 with her mother off of the Florida coast suffering from cold stress. The young manatee was chosen to participate in the U.S. Fish and Wildlife Service's Manatee Rescue and Rehabilitation Program and was sent to the Columbus Zoo to undergo rehabilitation. Two rehabilitated manatees just left the Cincinnati Zoo and Botanical Garden to go back to Florida to prepare for re-release into the wild. Woodstock joins one remaining manatee at the Cincinnati Zoo's Manatee Springs exhibit. Three manatees remain at the Columbus Zoo. The Columbus and Cincinnati zoos are the only two U.S. Fish and Wildlife Service's Manatee Rescue and Rehabilitation Program partners outside of Florida.

### Pelicans Released in California Photographed in Strait of Juan de Fuca, San Pedro

*CORTE MADERA, California, USA (January 10, 2013)*—Young pelicans marked with numbered leg bands and released under the Golden Gate Bridge, about 10 miles south of Corte Madera and Larkspur, have been photographed as far away as Vancouver Island, British Columbia, and San Pedro, according to a representative from International Bird Rescue (IBR).

The banding study by IBR surprised some researchers because it revealed some California brown pelicans fly north, not south, for the winter. It also showed that juvenile pelicans, less than a year old, were capable of flying 800 miles to British Columbia, over the course of several months, and 375 miles to San Pedro in a week's time.

Karen Benzel of IBR said in a phone interview that a young pelican known as P16 made the San Francisco-to-San Pedro flight in December. The bird was treated for fishing-line injuries at the nonprofit's Cordelia Center and released with blue band number P16 at Fort Baker under the Golden Gate Bridge on December 10 [2012]. The same bird was spotted and reported at Fort Baker on December 15, and a sighting and photos showed the same bird in San Pedro on December 22.

Earlier in 2012, two first-year birds, known as R36 and R41, were rehabilitated for fishing-tackle injuries and fish-oil contamination and released under the Golden Gate Bridge on August 23, Benzel said. The birds were sighted multiple times by researchers and birdwatchers on Vancouver Island, BC, in November.

"We knew that pelicans follow the fish, and that many feed along the coast of Oregon and Washington," Jay Holcomb, IBR director and head researcher of the Blue-Banded Pelican Project, said of R36 and R41.

### Second Chance Wildlife's Turn at a New Start

*WASHINGTON, District of Columbia, USA (January 3, 2013)*—Second Chance Wildlife is working on getting its own second chance these days—a new facility and a new director. The center learned last October from the Maryland-National Capital Park and Planning Commission (M-NCPPC) that it would have to relocate because of the deteriorating condition of the current building it rents from M-NCPPC on Barcellona Drive in Gaithersburg, said Frank Howard, head of Second Chance's board of directors.

"The existing facility [a residential property] they currently occupy is in need of much repair and is not a suitable building for their operations," said Melissa Chotiner, a parks department spokeswoman. "The intention always was to relocate to a more suitable facility."

The nonprofit wildlife rehabilitation group began looking for other facilities after receiving the letter, but for several months the effort "really went nowhere," Howard said.

Then a couple in the area gifted land they owned to the Maryland Department of the Environment. M-NCPPC is working out a deal to take over the 16-acre property in northwestern Montgomery County. The move would require that they knock down the decrepit building on that site and build a new one—an option unavailable at the current location.

The organization expects to move into temporary buildings on the new site by October 2013 and build a permanent facility there. Because the nonprofit group will be constructing the building, it has asked the parks department for a long-term lease of $1 annually. Second Chance has a building fund of about $200,000 but it has dipped into it in recent years to meet its annual costs—about US$288,000.

"For that area, Second Chance is a big deal; we really need them," said Terry Moritz, president of the Maryland Wildlife Rehabilitators Association. The number of rehabilitators has thinned in recent years as licensing requirements have toughened and four of the state's rehabilitators have died, she said. "People are not stepping up to take over for them," she said.

There are just two wildlife rehabilitation centers in Montgomery County, said Mary Goldie of the Wildlife and Heritage Service of the state's Department of Natural Resources, who licenses the state's wildlife rehabilitators.

### Sandy Sends Northern Birds Off Course

*SANIBEL, Florida, USA (January 1, 2013)*—Hurricane Sandy disrupted many human lives, and now some wildlife officials believe the superstorm may be to blame for a bird that is showing up in Southwest Florida, exhausted and starving. Wildlife specialists in Naples, Florida, have never seen a razorbill (*Alca torda*), but recently 19 of the birds were brought to wildlife rescues such as the Conservancy of Southwest Florida and the Clinic for Rehabilitation of Wildlife in Sanibel. The black and white waterbirds usually don't travel any farther south than Virginia.

Experts say the birds mostly stay between Maine and New Jersey and prefer breeding in Iceland. Sandy may have blown the small birds off course and destroyed their food supply. They are coming to Florida in search of food, but the long journey and lack of food they are used to eating is killing them. They normally eat schooling fish, crustaceans, herring, and other invertebrates. "It's exhaustion and emaciation," said Jessica Bender, wildlife rehabilitation specialist with the Conservancy. "They are just really skinny and really tired."

The first razorbill arrived at the Conservancy Dec. 19. Since then, six more have arrived. All of them have died. Most lived less than 24 hours after being treated. One survived about 48 hours.

Gareth Johnson, a first responder for the Clinic for Rehabilitation of Wildlife, said he has seen 12 razorbills there the past couple of weeks. Only two are still alive. "They are coming in emaciated and really, really weak," he said. "All we can do for them is give them fluids and give them food."

Razorbills have a tough time finding the food they need in Southwest Florida, Johnson said. "The fish up north tend to be a lot oilier," he said. "When they come down here, they are out of their element. They don't know how to deal with the different predators and their food source just isn't enough to sustain them."

Johnson said a lot of questions remain unanswered. If any of the razorbills survive, he does not know how or where they would be released. "This is all new to them, and this is all new to us," he said.

The University of Florida and the Florida Fish and Wildlife Conservation Commission now are studying the razorbills in Florida. Wendy Quigley, a spokeswoman for Fish and Wildlife Conservation Commission, said they have received lots of calls from curious bird watchers the past few weeks. Not knowing what bird they saw, some are describing seeing a bird that looks like a penguin. "For the past two weeks we had 28 reports through our website," she said.

Twenty dead razorbills have been reported to them, and they received eight carcasses to analyze, Quigley said. Necropsies have been completed on two of those. "The necropsy indicates that they were emaciated in appearance, and it was stress related," she said.

### Minnesota Wildlife Rehab Center has Record Year

*MINNEAPOLIS, Minnesota, USA (December 24, 2012)*—According to a report from Minnesota Public Radio News, the Wildlife Rehabilitation Center of Minnesota helped a record number of animals in 2012, treating more than 8,870 animals (200 more than the previous record set in 2010). The center's staff treats any animal that's brought in, according to Executive Director Phil Jenni. This time of year, the center sees more trumpeter swans with lead poisoning—treatment costs more than US$50 a day—and many crows exhibiting signs of West Nile virus.

### Oklahoma Rescue Group Proposes Shelter for Rural Rogers County

*CLAREMORE, Oklahoma, USA (December 23, 2012)*—An Oklahoma animal rescue group has come up with a possible solution to a problem plaguing rural Rogers County. Residents said they have noticed an increase in the number of stray animals, especially dogs. Annette Tucker, director of Wild Heart Ranch Wildlife Rescue & Rehabilitation, said many owners abandon their domestic animals.

"The problem is [that] Rogers County does not have a county shelter. Wild Heart is the only facility operating as a rescue in Rogers County," said Tucker, who adds that law enforcement agencies often turn to her facility for help caring for domestic animals that have been abandoned. While she loves taking in the animals, finding room for them at her wildlife rescue [clinic] can be challenging.

She has already raised about $55,000 of the $80,000 she needs to purchase the 40 acres of land.

### Wisconsin DNR Seeking Applicants for New Wildlife Rehab Council

*MADISON, Wisconsin, USA (December 17, 2012)*—The Wisconsin Department of Natural Resources is looking for applicants to serve on a new wildlife rehabilitation council. DNR Secretary Cathy Stepp is looking for people with experience in wildlife rehabilitation, wildlife health, and the captive wildlife industry to fill 18 three-year terms on the council. The group would advise the DNR on wildlife rehabilitation and captive wildlife matters as well as implement education programs and help the DNR inspect wildlife rehabilitation facilities.

Anyone interested can apply through the DNR's website (http://dnr.wi.gov).

# Treatment of Feral Rock Doves *(Columba livia)* Experimentally Infected with Paramyxovirus Type 1 Newcastle with Radical Doses of Cyanocobalamin and Adjuvant Therapy with Meloxicam and Sulfamethoxazole–Trimethroprim

**Antis G. George and Eiko Toda**



ABSTRACT: Sixteen feral rock doves were experimentally inoculated with paramyxovirus type 1 Newcastle disease (PMV-1) to assess the possible efficacy of radical doses of cyanocobalamin for the treatment of acute infection of PMV-1. These 16 feral doves were also given adjuvant treatment with meloxicam, a non-steroidal anti-inflammatory agent (NSAID), and sulfamethoxazole–trimethoprim. Infected rock doves were placed into two groups, the treated experimental group ($n = 8$) and the untreated control group ($n = 8$). Untreated infected control rock doves were inefficient at suppressing the virus and remained infected until the end of the study. Treatment with cyanocobalamin in combination with meloxicam and sulfamethoxazole–trimethoprim appeared to eliminate symptoms of the virus, suggesting a positive and conclusive effect of our treatment protocol. We conclude that this treatment protocol may be effective in treating acute cases of PMV-1; however, these results may not be valid for chronic PMV-1 infection.

**KEY WORDS:** Avian, *Columba livia*, cyanocobalamin, paramyxovirus type-1 Newcastle disease, treatment.

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## Introduction

The genus *Columba* species, including *Columba livia* the feral pigeon, were originally dismissed as having the ability to carry and transmit Newcastle disease virus (NDV). However, contrary to past notions, NDV paramyxovirus type 1 (PMV-1), in particular, is now known to be endemic worldwide in a variety of bird species such as the racing pigeon. Therefore, NDV is of specific economic importance to commercial poultry. Although NDV is primarily investigated in domestic and commercial bird species, both direct and vertical transmission between the domestic and wild populations have been heavily documented (Ujvári *et al*. 2003; Liu *et al*. 2006; Oliveira *et al*. 2007). PMV-1 is a non-segmented, single-stranded, negative-sense RNA virus, highly contagious and, in pigeons, infers a morbidity of 30–70% and mortality of 40%, significantly higher than

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the mortality rate of <10% in healthy pigeons (Cross 1995; Liu *et al.* 2003; Ujvári 2006). This enveloped virus is easily transmissible through direct and indirect means after a 48-hr incubation period via secretions and excretions of the respiratory and gastrointestinal tract, depending on the target location of viral replication. Vertical transmission of this virus has been documented to occur through infected feed products as well as via contact with infectious feces (Oliveira *et al.* 2007).

Additionally, in species of the *Columba* genus, PMV-1 is easily distinguishable due to the characteristic sequence of clinical symptoms which arise in the respiratory tract, gastrointestinal tract, and nervous systems. These symptoms can also vary in severity into the three subtypes of velogenic, mesogenic, and lentogenic strains (Kapczynski *et al.* 2006). The general symptoms of the virus include dyspnea, watery to bloody diarrhea, polyuria, polydipsia, dehydration, anorexia, inflamed orifices, opisthotonos, neurological dysfunction, lethargy, ataxia, unilateral or bilateral paralysis of the wings or feet (or both), and torticollis (Tully *et al.* 2009) (see Fig. 1)

Although the virus has been shown to terminate its infectivity (that is, the shedding abilities) after a 9-wk period, birds that have contracted this virus can be kept alive for this duration through treatments and procedures detailed further in this study. Upon survival of the 9-wk period, these recovered birds are no longer considered carriers of the virus (Stocker 2005). However, it is recommended that further treatments should include the vaccination of these birds with a subcutaneous injection to the dorsal base of the neck with Columbovac PMV® (Pfizer, Sandwich, Kent, United Kingdom) to prevent re-infection upon subsequent contact with the virus, thereby providing initial local nervous-system immunity followed by general immunity (Liu *et al.* 2006a).

The aim of this study was to artificially infect feral rock doves, and observe the benefits to infected birds of radical doses of cyanocobalamin in addition to adjuvant therapy with a non-steroidal anti-inflammatory agent (NSAID) and a blood–brain membrane permeable antibiotic. We also detail the symptoms and pathological effects of paramyxovirus on various target organs.

FIGURE 1. Torticollis in an infected rock dove.

## Materials and Methods

### *Captive Management, Transmission, and Inoculation*

*Pre-treatment*

Sixteen adult feral rock doves were used in this study and were obtained from the feral population in Toronto, Ontario; all were submitted to the Toronto Humane Society – Wildlife Rehabilitation Department by members of the public. Birds were maintained in compliance with biosafety guidelines and animal use and care protocols were approved by the Toronto Humane Society Board of Directors and the Chief Veterinarians Committee. In order to ensure non-infected subjects, the birds that arrived for our study were first quarantined for 10 days because as feral birds they were susceptible to previous PMV-1 exposure. Quarantine was conducted in a non-ventilated room with no windows or other birds in immediate vicinity. On physical examination they appeared to be healthy and anatomically correct; respiration, heart rate, and temperature were all within normal limits (Table 1). Abdominal palpation as well as examination of the orifices showed no abnormal findings. Mucous membranes were pink, lung sounds were clear (eupneic), and they exhibited normal mentation; quiet, alert, and responsive. The rock doves were placed into two groups, the experimental group ($n$ = 8) which would undergo treatment and the control group ($n$ = 8) which would remain untreated.

*Transmission and inoculation*

Upon completion of the 10-day quarantine, all parameters were again recorded and were within normal limits. The rock doves were simultaneously exposed to a rock dove infected with a neurotropic and velogenic strain of PMV-1, as determined by clinical symptoms including marked and characteristic neurological dysfunctions after being brought for rehabilitation. After a 5-day inoculation period, blood was drawn from the original PMV-1 host via venipuncture of the left brachial vein and directly transfused into the median tarsometatarsal vein of all 16 birds to ensure complete and successful exposure and transmission. A diagnosis of PMV-1 was later confirmed on all 16 rock doves based on typical clinical symptoms. The original host was no longer required in the study and was humanely euthanized by a barbiturate overdose (Table 2).

### *Handling of Infected Birds*

*Housing and feed*

The study was conducted in the Wildlife Rehabilitation Department facilities of the Toronto Humane Society. As recommended minimum standards suggested, PMV-1–infected birds were housed in separate cages with parameters of from 12" × 12" × 12" to 16" × 8" × 8" (W × L × H, respectively) (Stocker 2005). Food and water were provided *ad libitum*. Feed for both healthy birds prior to inoculation and infected birds consisted of a high-quality premium dove mix feed or rock dove feed with pigeon grit to aid in digestion. When indicated for use, liquid gavage feed was of high quality; in particular, parrot-rearing formula was used and is ideal for use as supportive care. Liquid gavage feed was only initiated on those birds where neurological insult was great, primarily caused by torticollis, causing an inability to feed.

**TABLE 1. THIS TABLE HIGHLIGHTS THE AVERAGE CLINICAL PARAMETERS FOUND IN FERAL ROCK DOVES.**

| WEIGHT RANGE (G) (APPROXIMATE) | BEATS PER MINUTE (APPROXIMATE) | RESPIRATION RATE/MINUTE (APPROXIMATE) | TEMPERATURE °C (RECTAL) (APPROXIMATE) |
|---|---|---|---|
| 260–510 | 150–300 | 30–50 | 40–42 |

**TABLE 2. THIS TABLE DETAILS THE ANAESTHETIC, SEDATIVE, AND EUTHANASIA AGENTS USED TO IMMOBILIZE AND EUTHANIZE BIRDS.[1]**

| DRUG | DOSAGE (MG/KG) | COMMENT |
|---|---|---|
| (I) | INDUCTION 5% | RECOMMENDED ANESTHETIC CHOICE |
| (K) + (D) | (K) 5 TO 30 MG/KG + (D) 0.5 TO 2 MG/KG; IM | 20–25 MIN DEEP SEDATION |
| (B) | 0.4 TO 3 MG/KG; SC, IM | EXCELLENT SEDATION |
| T-61 | 0.3ML/KG; IC, IP, IV | FAST ACTING EUTHANATIZING SOLUTION |

[1](I) = Isofluorane; (K) = ketamine; (D) = diazepam; (B) = Butorphanol; IM = intramuscular; SC = subcutaneous; IC = intracardiac; IP = intraperitoneal; IV= intravenous.

*Isolation protocol*

In addition to quarantine of the study birds, caretakers of infected birds adhered to strict hygienic practices. Caretakers did not enter the quarantine room of infected birds without stepping into a disinfectant foot bath and then placing booties on shoes. Furthermore, when handling infected birds in quarantine, isolation gowns and gloves were worn; when exiting quarantine, gowns, gloves, and booties were disposed of in a proper biohazard-grade receptacle. To ensure that there was no cross-contamination from infected to healthy birds that were in rehabilitation elsewhere at the clinic, this room was only entered at the end of each day.

*Treatment protocol*

Treatments were started 20 days post-inoculation and clinical symptoms were noted as they appeared throughout this study prior to euthanasia. The experimental group ($n$ = 8) rock doves were treated with radical doses of cyanocobalamin (600 µg/kg once a day, every 2 days, through intramuscular injections for 26 days); cyanocobalamin has been shown to suppress the virus with a normal dose of 50 µg/kg. In conjunction with cyanocobalamin, a non-steroidal anti-inflammatory drug (NSAID) was introduced; meloxicam (0.5 mg/kg os, once a day for 26 days). This drug was used in the treated experimental group only to reduce the inflammation and discomfort caused by neurological symptoms, specifically torticollis (Carpenter 2004). Sulfamethoxazole–trimethoprim (50 mg/kg per os, twice a day for 26 days) was introduced as an antibiotic against secondary septic infection. This drug also served as an antibiotic for the central nervous system (CNS), as it was blood-brain membrane permeable (Green et al. 1989). All three drugs were used in conjunction with each other throughout the 26-day treatment regimen. After 120–125 days of quarantine, the treated infected birds showed no clinical symptoms suggestive of PMV-1 (Fig. 2). None of the above treatments were administered to the untreated control group ($n$ = 8).

*Euthanasia*

The 16 birds were euthanized by their original groups, group 1 ($n$ = 8) and group 2 ($n$ = 8). This was done principally to investigate various euthanasia protocols commonly encountered in wildlife rehabilitation in order to establish both and economic and practical approach. Group 1 was first sedated using butorphanol tartrate at 3 mg/kg intramuscularly. After desirable sedation was acquired, a commercial euthanatizing agent, T-61 (active ingredients:

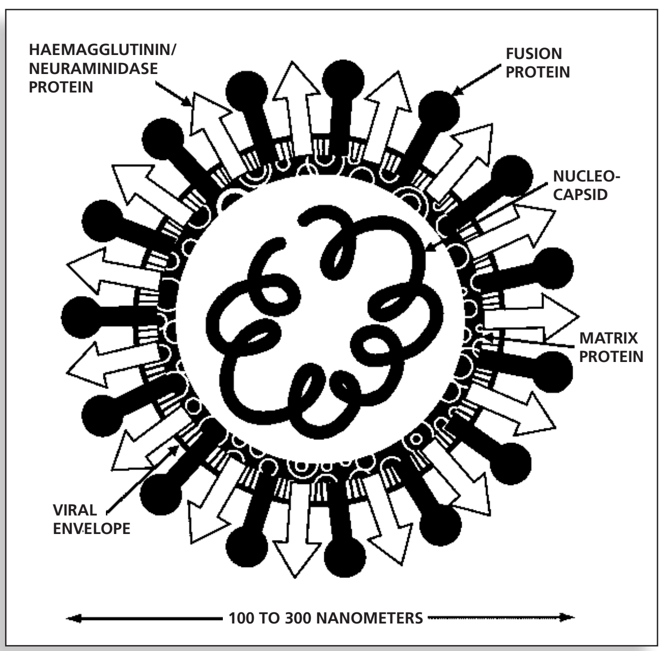




Figure 2. Diagrammatic representation of Newcastle disease virus.

**TABLE 3: SUMMARY OF CLINICAL SYMPTOMS, NECROPSY RESULTS, RAISED LESIONS IN ORGANS, AND DEFINITIVE DIAGNOSIS OF PARAMYXOVIRUS TYPE 1 NEWCASTLE.** THIS TABLE OUTLINES THE CLINICAL FINDINGS, POST-MORTEM RESULTS, AND WHETHER THE BIRD WAS POSITIVE FOR THE VIRUS.

| SUBJECT | CLINICAL SYMPTOMS[a] | NECROPSY (RAISED LESIONS BY ORGAN)[b] | | | | | | | | | DIAGNOSIS OF PMV-TYPE 1 BASED ON CLINICAL SYMPTOMS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | B | H | L | R | K | S | P | T | C | |
| **EXPERIMENTAL GROUP (*n*=8)** | | | | | | | | | | | |
| 001 | N,D,T,A,Pl,Pd,DyS | - | + | - | + | + | - | - | - | - | + |
| 002 | N,D,T,PaW,An,Op | - | - | + | + | + | - | - | - | - | + |
| 003 | N,D,T,A,An,PaW | - | - | + | + | + | - | - | - | - | + |
| 004 | N,D,PaW,PaF,A,An | - | - | - | + | + | - | - | - | - | + |
| 005 | N,D,T,PaF,An | - | + | - | - | - | - | - | - | - | + |
| 006 | N,D,A,Op,DyS | - | - | - | - | + | - | - | - | - | + |
| 007 | N,D,T,A,PaW | - | - | + | + | + | + | - | - | - | + |
| 008 | N,D,T,A,An,Op | - | - | - | + | - | + | - | - | - | + |
| **CONTROL GROUP (*n*=8)** | | | | | | | | | | | |
| 001 | N,D,T,PaW,An,Op | - | + | - | + | - | - | - | - | - | + |
| 002 | N,D,T,PaW,PaF | - | - | - | + | + | + | - | - | - | + |
| 003 | N,D,A,An,PaF,DyS | - | - | - | + | + | - | - | - | - | + |
| 004 | N,D,T,A,An,Op | - | + | - | - | - | - | - | - | - | + |
| 005 | N,D,A,An | - | - | - | + | - | - | - | - | - | + |
| 006 | N,D,T,A,An,PaW,PaF,Op | - | + | + | + | - | - | - | - | - | + |
| 007 | N,D,T,A,An,Op | - | + | + | + | + | - | - | - | - | + |
| 008 | N,D,T,An,DyS | - | - | - | + | + | - | - | - | - | + |

[a]N = neurological dysfunction; D = diarrhea; T = torticollis; A = ataxia; Pl = polyuria; Pd = polydipsia; DyS = dyspnea; PaW = paralysis of wings; An = anorexia; Op =opisthotonos; PaF = paralysis of feet.
[b]B = brain; H = heart; L = liver; R = lung; K = kidney; S = spleen; P = pancreas; T = trachea; C = Colon; (+) = positive or encountered; (-) = negative or not encountered.

embutramide, mebezonium iodine, tetracaine hydrochloride) was used intracardiacly (0.3 ml/kg). Death was achieved instantaneously. Group 2 was induced into an unconscious state using isofluorane at 5% via face mask mixed with 100% oxygen. Once an ultimate state of anesthesia was reached, T-61 was administered (0.3 ml/kg) intrapectorily and 2 min passed before death was accomplished. All agents and doses used for euthanasia are detailed in Table 2.

*Necropsies*

Complete necropsies were required to attain a definite confirmation of positive or negative responses to our treatments, and they were held on-site at a private veterinary clinic post-study. Necropsies were performed on target organs previously defined in the literature as possible areas of viral insult and were compared based on the presence or absence of classical raised lesions as well as serosal hemorrhages in the gastrointestinal tract (Table 3) (Barbezange and Jestin 2002). For the purpose of this study, observations were made based solely on gross post-mortem findings; histological samples were not obtained.

## Results

Following viral inoculation, a predetermined treatment protocol was initiated on the experimental group. No statistical differences were found between the groups in regard to age, sex, or clinical manifestations. Four (50%) out of eight birds showed significant improvement within 60 days post-introduction to drug therapy.

On day 75 clinical symptoms such as torticollis were recognized to be resolved in two (25%) out of the eight birds initially presenting with that particular manifestation. On day 90 physical examinations commenced on all birds; results from the examination show that seven (87.5%) out of eight birds had resolved diarrhea, which can be interpreted to indicate that viral shedding via the gastrointestinal tract may have been obsolete.

In addition, birds that had developed CNS disease showed remarkable recovery. Symptoms such as ataxia, paralysis, and opisthotonos were undetectable in six (75%) out of eight birds. Birds that initially presented with respiratory impairment such as dyspnea were noted to have regular breathing patterns as well as eupneic lung sounds.

Observations from day 95 to 110 showed that birds with initial signs of polyuria and polydipsia were drinking and urinating less. On day 115 birds had resolved the initial renal insult. Previously documented signs of anorexia were noted to evaporate in all birds throughout days 113–117. After 125 days of treatments, all eight (100%) birds showed no evidence of clinical symptoms suggestive of paramyxovirus as well as no evidence of morbidity. Subsequently, following the expiration of the study, birds showed no substantiation of neurological insult; this was documented in 100% of subjects post-inoculation. The non-treated control subjects were inefficient at suppressing the virus and remained symptomatic until the end of the study (data not shown).

## Discussion

Observations showed that previously defined symptoms linked with paramyxovirus were consistent with what we saw in the infected study birds, although within our sample group subjects varied in their particular manifestations. Previous literature on the virus implied that inflicted birds initially shed predominately through the respiratory route followed by a marked shift for the gastrointestinal pathway (Cross 1995; Kinde *et al.* 2004; Ministry of Natural Resources 2006). However, 90% of subjects showed premature clearance of gastrointestinal symptoms, leading us to believe that viral shedding may have been terminated earlier than previously hypothesized.

In this particular study we thought it of importance to analyze harvested tissue on a gross scale, rather than on a histological scale, in order to determine the presence or absence of specific necrotic patterns. Interpretation of the results showed that there was significant lesioning of tissues but, contrary to our hypothesis, we found no correlation between clinical symptoms and the target tissues that presented lesions. Although we observed tissue on a gross scale, we would encourage further study using molecular and cellular techniques to determine whether or not further damage was caused by the virus on a microscopic scale. In addition, subsequent studies may find it of interest to retrieve samples throughout the course of infection to obtain a sequential series of pathological damage.

Previously defined treatments throughout the literature indicate that the use of cyanocobalamin in avian species with viral infections aided in the recovery or supportive care of affected birds (Cross 1995; Torro *et al.* 2005). The aim of this study was to implement a treatment protocol including cyanocobalamin at an exaggerated dose to see if a higher dose was more successful in aiding in recovery. We started with an arbitrary dose, which we implemented at a much higher dose than that recommended for domesticated species (Biancifiori and Fioroni 1983; Barbezange and Jestin 2002, 2004; Kapczynski *et al.* 2006). In addition to radical doses of cyanocobalamin, adjuvant therapy with meloxicam and sulfamethoxazole-trimethoprim was also used.

In support of our hypothesis we found that eight (100%) of our experimental subjects exhibited full recovery, and the alleviation of all symptoms indicated a positive and conclusive affect of our treatment plan. However, using excessive doses of this drug can prove costly and, therefore, uneconomical; future studies may find it useful to narrow the dosage range in order to define a universal affective dosage for use in species that acquire PMV-1. Future studies should include polymerase chain reaction (PCR) as a tool in the diagnoses and confirmation of the virus rather than relying only on a symptomatic diagnosis (Seal *et al.* 1999; Marlier and Vindevogel 2005). A larger study group is also required for further analysis and data interpretation and would assist in finding statistically significant conclusions.

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# Background Music to Reduce Startle Response in Wild Avian Species During Rehabilitation

**Ann Goody, Rachel Ferris, Marianthi Gelatos, and Charmayne Yim**



Bonin Petrel (*Petrodroma hypoleuca*).

**ABSTRACT:** In accordance with traditional standards, wildlife rehabilitation facilities strive to keep their patient environment quiet and stimuli free. However, nature is not silent nor do all stimuli cause stress. Auditory stimuli can trigger the hypothalamic-pituitary-adrenal axis (HPA), leading to the production of corticosteroids. This study was established to determine if background music acts as a reducer of auditory stressors as indicated by a reduction of visible startle responses. Through an observational study over 2 yr, with various avian species, Three Ring Ranch keepers monitored the number of startle responses while radio music played in an adjacent room and when no music was played. Easy listening music was played at 50–63 decibels (dB), as measured in the animal treatment room by an LAS (slow, A-weighted sound level; collectively dBA) handheld meter. A noticeably lessened startle response to extraneous sounds produced during day-to-day facility operation was observed. Furthermore, our data suggest that background music may reduce the frequency of startle response and the severity of the response and may, therefore, be advantageous in the rehabilitation of wild avian species.

**KEY WORDS:** Auditory stimuli, avian, background noise, minimum standards of care, music, startle response, wildlife, wildlife rehabilitation

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## Introduction

Widely accepted standards for the care and treatment of injured wildlife incorporate recommendations for the appropriate enclosures within rehabilitation facilities. These recommendations include covering cage doors, providing visual barriers, positioning cage fronts away from human activity, removal of radios, and placing cages far from areas of high traffic noise (Miller 2000). Although most wildlife rehabilitators follow these methods to the best of their ability, it is neither physically possible nor psychologically beneficial to the animal to eliminate all sound from the environment. In fact, it has been found to be detrimental to the animal, a phenomenon known as sensory deprivation (Gravel and Ruben 1995). During stages of critical development, it is especially harmful for an animal to experience sensory deprivation because it can impede the development of neural synapses in the brain (Schierloh *et al.* 2003). Eliminating sound altogether is also unrealistic due to the fact that nature is not silent. In nature, sound pressures range from 20–40 dB (Morgan and Tromborg 2007), depending on the natural habitat of the animal. In rehabilitation facilities, sound pressures can be within a much higher range and may cause animals to exhibit stress.

The goal of a rehabilitator is to let the wild animal recover in a stress-free environment; this fact causes us to re-evaluate accepted stressors. A stressor is any external factor that disrupts the overall well-being of the animal, including homeostasis, thus setting off a sequence of physiological events that prepare the body for a "fight or flight" response (Morgan and Tromborg 2007). Short-term stressors, such as sudden noises, can cause observable behavioral responses including looking in the direction of the stimulus, startling off a perch, alarm vocalizations, or animals battering their bodies against the sides of an enclosure (Morgan and Tromborg 2007).

In order to reduce the number of startle responses caused by abrupt noises, background radio music is now utilized at the Three Ring Ranch Exotic Animal Sanctuary to mask the effect of such noises and attempt to reduce startle responses. Facility personnel observed that having the radio on in an adjacent room appeared to reduce stress-related behaviors of the animals, presumably by lessening the impact of sudden noises at higher decibel levels. Previous studies with various species indicate the positive effects of music on captive animal health and welfare. A study testing the effect of stereo music on chimpanzees showed a reduction in aggressive behavior and an increase in relaxed social behavior (Howell *et al.* 2003). Similarly, classical music used as a form of auditory stimulation—as opposed to bio-specific rainforest sounds or no music at all—for zoo-housed gorillas caused gorillas to exhibit more-relaxed behavior (Wells *et al.* 2006). Originally designed as behavioral enrichment, this study also suggests that using music may not be as much a form of sensory enrichment as it is a "mask" for everyday background noises experienced in a public zoo environment (Wells *et et al.* 2006). Another study found that cotton-top tamarins (*Saguinus oedipus*) did not respond to emotional aspects of human-based music but did react emotionally to music composed in their frequency range and tempo (Snowdon and Teie 2010), which led to the use of species-specific music. Some may argue that, because the species involved in these studies are primates, their response to music may be more similar to that of humans than of other animal species (Howell *et al.* 2003). However, further studies with non-primates have comparable findings, showing that some other mammal species respond similarly to background music.

One such study involved the housing of canines in a stressful environment. Dogs in a kennel environment that were exposed to classical music selections exhibited less body shaking, and more time sleeping rather than moving around and vocalizing (Kogan *et al.* 2011). A sector of the animal husbandry community already supports, and even encourages, the use of background music to reduce stress in species prone to hyperarousal (van de Weerd and Baumans 1995). In a resource created for laboratory animal caretakers, van de Weerd and Baumans (1995) suggested radio music be used as background noise for small prey animals, such as guinea pigs, because they seem to startle easily.

We were unable to locate any studies that provided data (related to avian species) which indicated that background music had the same effect on birds. However, we believe that the cited mammal studies, along with our observations, suggest there may be similar benefits to birds. To our knowledge, our study is the first to examine wild avian species through 1) use of background music to mask acute auditory stressors, and 2) an evaluation if background music reduced the startle response in birds.

**TABLE 1. TESTED AND MEASURED SOUNDS REPRESENTING ACUTE AUDITORY STIMULI DURING ROUTINE FACILITY OPERATION.** ALL SOUNDS WERE MEASURED WITH A HAND-HELD LAS METER SET ON SLOW- WEIGHTED A SOUND LEVEL (=DBA).

| MEASURED SOUNDS | DECIBEL (DBA) | CHANGE IN DBA FROM BASELINE WITH RADIO |
|---|---|---|
| Radio | <50–63 | 0 |
| Car door closing | 63 | <1–10 |
| Feed room door closing | 69 | <0–7 |
| Volunteers speaking | 53–65 | <0–15 |
| Car horn | 66 | <3–16 |
| Walking on gravel | 54 | <0–4 |
| Dishes clattering or dropped | 64–71 | <1–21 |

## Materials and Methods

The study took place over a 2-yr period and consisted of observing the startle responses of varying avian species in rehabilitation at the Three Ring Ranch Exotic Animal Sanctuary. All wildlife being rehabilitated was kept in a treatment room within our barn facility; the door to this room was kept closed at all times. All patients were kept in species- and injury-appropriate caging following the accepted standards for wildlife rehabilitation (Miller 2000). All patients observed during this study were presented a single variable: radio off or radio on. All other conditions such as habitat, visual, and olfactory stimuli were kept constant for the duration of the observation period. The radio was also kept on the same easy-listening station and the volume level on the radio was kept constant, with a range of 50–63 dBA determined by fluctuations within songs measured in the treatment room. The decision to use either a sound level ("Fast" or "Slow") or an Leq/Lavg is usually determined by any measurement regulations that are being followed or by the nature of the noise being measured. The sound level, expressed in decibels (dB), is the basic measurement used for many applications. Under "Slow weighting" (dBA), the needle would be damped to smooth out the noise so it is easier to read. Hand-held meters of this kind produce accurate readings and are reasonably priced. The more advanced Leq/Lavg equipment begins at over US$5,000 and is usually only required for OSHA or commercial applications. For the purpose of this discussion only, white noise is defined as a base auditory stimulus and ranges from approximately 50–63 dBA. The distance from the radio to the treatment area remained constant at 10.36 meters. All wildlife species observed were studied under the same "everyday facility" sounds listed in Table 1 under both periods of care. Testing began on day one post-arrival for care. This allowed us to see the responses prior to any habituation to facility noises. To monitor the patients' startle responses, a mirror was set up in the barn's treatment room

**TABLE 2. THE RECORDED STARTLE RESPONSE FOR INDIVIDUALS OF EACH SPECIES OBSERVED UNDER TWO, 30-MIN OBSERVATION PERIODS.**

| ORDER, SPECIES, AND TOTAL | TEST PERIOD A **RADIO OFF** | | | TEST PERIOD B **RADIO ON** | | |
|---|---|---|---|---|---|---|
| | NO STARTLE | BRIEF STARTLE | FULL STARTLE | NO STARTLE | BRIEF STARTLE | FULL STARTLE |
| **PASSERIFORMES** | | | | | | |
| HOUSE FINCH *(Haemorhous mexicanus)* | 0 | 0 | 2 | 0 | 0 | 2 |
| NORTHERN CARDINAL *(Cardinalis cardinalis)* | 0 | 0 | 1 | 1 | 0 | 0 |
| **TOTAL** | **0** | **0** | **3** | **1** | **0** | **2** |
| **FALCONIFORMES** | | | | | | |
| HAWAIIAN HAWK *(Buteo solitaries)* | 0 | 0 | 7 | 7 | 0 | 0 |
| HAWAIIAN OWL *(Asio flammeus sandwichensis)* | 0 | 0 | 1 | 0 | 1 | 0 |
| BARN OWL *(Tyto alba)* | 0 | 0 | 6 | 6 | 0 | 0 |
| **TOTAL** | **0** | **0** | **14** | **13** | **1** | **0** |
| **ANSERIFORMES** | | | | | | |
| NENE (*Branta sandvicensis*) | 0 | 0 | 4 | 4 | 0 | 0 |
| **TOTAL** | **0** | **0** | **4** | **4** | **0** | **0** |
| **PHAETHONTIFORMES** | | | | | | |
| WHITE-TAILED TROPIC BIRD (*Phaethon lepturus*) | 0 | 0 | 1 | 1 | 0 | 0 |
| **TOTAL** | **0** | **0** | **1** | **1** | **0** | **0** |
| **CHARADRIIFORMES** | | | | | | |
| SOOTY TERN (*Onychoprion fuscatus*) | 0 | 0 | 3 | 1 | 0 | 2 |
| **TOTAL** | **0** | **0** | **3** | **1** | **0** | **2** |
| **PROCELLARIIFORMES** | | | | | | |
| CHRISTMAS ISLAND SHEARWATER (*Puffinus nativitatis*) | 0 | 0 | 1 | 1 | 0 | 0 |
| WEDGE TAILED SHEARWATER (*Puffinus pacificus*) | 0 | 0 | 5 | 3 | 2 | 0 |
| NEWELL'S SHERWATER (*Puffinus auricularis newelli*) | 0 | 0 | 1 | 1 | 0 | 0 |
| HAWAIIAN PETREL (*Pterodroma sandwichensis*) | 0 | 0 | 3 | 3 | 0 | 0 |
| BAND-RUMPED STORM PETREL (*Oceanodroma castro*) | 0 | 0 | 1 | 0 | 1 | 0 |
| SOOTY STORM PETREL (*Oceanodroma tristrami*) | 0 | 0 | 5 | 5 | 0 | 0 |
| BONIN PETREL (*Petrodroma hypoleuca*) | 0 | 0 | 1 | 1 | 0 | 0 |
| **TOTAL** | **0** | **0** | **17** | **14** | **3** | **0** |
| **TOTAL** | **0** | **0** | **42** | **34** | **4** | **4** |


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Juvenile barn owls *(Tyto alba).*

and a chair was placed outside that afforded a view of the mirror. The door to the treatment room was opened just enough to see both the mirror and the sound meter. The setup was maintained so that there would be no disturbance when preparing for observation periods. Birds were first observed with the music off and, when facility noises occurred, the bird's behavior was noted. The startle response to each sound was recorded and categorized as no startle response, brief startle, and full startle response. A quick turn of head or slight postural change of less than 3 sec duration, which exhibited a mild stress behavior at the moment of noise but returned to normal behavior very rapidly, was defined as "brief." A full postural change, stepping off perch or moving back for more than 3 sec, was defined as "full" startle behavior. A "no startle" response was assigned to patients that did not exhibit any of the startle behaviors described above. When the facility was quiet during an observation period, routine noises (examples include car door, footfalls on gravel, and dropping water pans) were deliberately created at a distance from the treatment room. Then music was turned on, the same noises were made, and observations of any response was noted. At the end of the 30-min observational period, data were compiled and grouped by order based on the degree of response for each species (Table 2). Each 30-min observation period included multiple auditory stimuli that had the potential to cause significant startle responses during both the periods of music on and music off. During their rehabilitation, each bird was assessed twice for 30 min. Observations were made on a wide variety of avian species under rehabilitation, as this accurately reflects our avian patient population. While startle responses vary based on species, all experience auditory stimuli while in care and all species exhibit measurable startle responses (Cockrem 2007; see further discussion in Results).

To analyze the results, a Wilcoxon signed-rank test for nonparametric data was run. The data were grouped according to species to give a sample size of $n$ = 15 (Table 2). The three categories of no startle, brief startle, and full startle response were organized into two categories in order to perform the test. The no startle and brief startle categories were combined to create a new "lessened startle" category in order to compare the change in response of the patients with an emphasis on whether one treatment is more likely to cause a high degree of startle. This allowed us to perform the directional Wilcoxon signed-rank test on the difference between the discrete number of lessened startle responses and full startle responses for all species observed. The null hypothesis was that there would be no difference in startle response between the radio being on and radio off.

## Results

The compiled data showed an observable difference in startle response between the two groups, with radio on showing less startle than radio off. Of the 42 individuals observed, all 42 showed a full startle response to the tested sounds without a radio playing background music. In contrast, with the radio on, only 4 of the 42 individuals showed a full startle response, 4 showed a brief startle response, and 34 showed no observable startle response. However, not all species or individuals responded identically to the test (Cockrem 2007). Some species, particularly the "flighty" species such as finches, showed full startle responses within both periods. Within some species, certain individuals responded differently to the two periods, with some exhibiting an improvement in startle response and some exhibiting no difference. Despite this, there was an overall decrease in startle response among the observed wildlife from full startle, to brief or no startle, when changing from the radio off to the radio on.

We established significance at a value of $P \leq 0.05$. The Wilcoxon signed-rank test showed a significant non-zero difference between the two observational periods, with startle response from having the radio off being greater than that when the radio was on ($Z$ = 3.28; $n$ = 15; $P < 0.001$). Because the probability of obtaining these results by chance is below the critical value, we rejected our null hypothesis and concluded that there was a statistically significant difference between the two observational periods within our sample population.

## Discussion

We believe that our results suggest the beneficial effects of using music as a masking sound to lessen the startle effect in rehabilitating wildlife. Intense noise can be frightening, especially to naive individuals. With repeated exposure, all vertebrates habituate or adapt behaviorally and physiologically to noise (Bowles 1995). It is not unusual to see a difference in responses, even within a species, because corticosterone stress responses and behavioral responses to stimuli vary markedly between individual birds (Cockrem 2007). Instead of striving for an absolutely silent environment, we suggest that wildlife rehabilitators focus on minimizing potential stressors caused by sudden auditory stimuli. At Three Ring Ranch, background radio music proved to be an effective method for minimizing the response to startling noises. We do not wish to imply that the radio music should be used in such a way that wildlife could become habituated to humans. The usual precautions of visual screens and avoidance of handling must be followed. We simply present our observations in order to demonstrate the impact that background music had on lessening startle responses in birds during our study. It has been demonstrated that long-term noise stress can lead to increased blood pressure and tachycardia due to the extended activation of the hypothalamic-pituitary-adrenal axis (Morgan and Tromborg 2007). These conditions put excess metabolic demands on the body, diverting crucial resources away from the healing process (Gage and Duerr 2007). With further research, it may be proven that reducing the startle response will also reduce stress.

At Three Ring Ranch, animals brought for care are eventually moved from the treatment room to aviaries, mews, or a flight cage—where they experience normal auditory stimuli as they recuperate. These structures are distant from the sound of the radio. We used background radio music during the initial rehabilitation period to prevent overwhelming the animal by the sounds that occurred within the confines of the barn.

The decibel level of the background music is generally lower than that of many sudden noises produced around the facility. Although the sound pressure from the radio is lower, it appears to mask any potential pressure created by sudden sound fluctuations. When a sudden noise occurs, the animal has already habituated itself to a certain level of sound (Bowles 1995). The jump in sound pressure caused by the sudden noise would be less than if there were complete silence. For example, if a volunteer slammed a door at a level of greater than 60 dBA, and the radio was playing at 50 dBA, the change in sound level would only be 10 dBA. If the radio was off, the change in sound pressure would be much greater—a jump from 0 to 60 dBA, which is much more startling to an already tense animal.

In a veterinary clinic setting, isolation rooms may be used for wildlife rehabilitation but they are not completely sound-proof. The predatory sounds of dogs barking and cats meowing may be present in these rooms and are potential auditory stressors (Hendrie and Neill 1991; Remage-Healey et. al. 2006; Morgan and Tromborg 2007). Background music may help to mask these sounds and, thus, minimize adverse effects.

Despite the limited conclusions available from other qualitative research, this study was purely observational in order to ensure the well-being and success of the rehabilitated patients at Three Ring Ranch. Many of the patients are endangered or fragile species (or both) that should not be put under the excess stress of multiple blood draws during the study. Further studies (at a rehabilitation facility treating non-endangered species) testing physiological and psychological changes, including blood work with corticosteroid levels as well as species-specific background sounds, are needed to confirm the true effectiveness of using background music as a tool to reduce stress arising from sudden noises.

## Conclusion

Even though the commonly accepted practice during wildlife rehabilitation is to remove the animal to a quiet room away from auditory stimuli, our data indicate that using background radio music to decrease the frequency of startle events in avian species is a viable treatment option. While further experimental research is required to confirm the observed benefits of background music, the statistical significance of our data suggests that use of music as background noise in wildlife rehabilitation facilities may be advantageous.

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Ann Goody

PHOTO © NORM GOODY.

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Marianthi Gelatos

**Charmayne Yim** is a graduate of the University of Guelph (June 2012) with a Bachelor of Science, Honours degree; she majored in Animal Biology and minored in Nutritional and Nutraceutical Sciences. She will be starting study at the University of Melbourne for her Doctor of Veterinary Medicine degree in early 2013. She is aspiring to specialize in exotic–pocket pets.

Charmayne Yim

# Statistical Analysis of Juvenile American Robin Rehabilitation at Willowbrook Wildlife Center, Illinois, USA: Can Admission Weight Be Used to Predict Rehabilitation Outcome?

**Ellen Haynes, Hollis N. Erb, and Jennifer Nevis**



**ABSTRACT:**

We examined the association between rehabilitation outcome (released vs. died or euthanized) and admission weight for apparently healthy juvenile American robins *(Turdus migratorius)* rehabilitated at Willowbrook Wildlife Center (WWC), Glen Ellyn, Illinois, United States from 2008 to 2011. The overall release rate for study robins was 47% ($n$ = 688; 95% confidence interval 43–51%) and the median admission weight for released study robins (45g) was significantly higher than that for study robins that died or were euthanized (40 g) ($P < 0.0001$). This finding was likely due to heavier birds being healthier or older and, therefore, more able to survive the stresses of the rehabilitation process. We could not determine a weight cut-off for initial admittance of juvenile robins for rehabilitation that might optimize release success, as no obvious cut-off was observed on the receiver operating characteristic curve. Overall, weight was not a conclusive predictor of rehabilitation outcome. This study is one example of how analysis of wildlife rehabilitation data provides valuable information about the success rate of rehabilitation efforts and how to best allocate wildlife rehabilitators' efforts to maximize release rates.

**KEY WORDS:** Admission weight requirement, American robins, juvenile passerines, release rate, statistical analysis, wildlife rehabilitation

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## Introduction

Wildlife rehabilitation is a complex endeavor for which success depends on numerous factors. There is no standard definition for success in this field but it is generally defined as the return of animals to the wild (Johnson 1986b). Rehabilitators can control some of the factors that influence success (e.g., diet and housing) while other factors are beyond their control (e.g., age and condition of the animal when it is brought to the rehabilitator).

Juvenile birds that appear healthy are one of the largest groups of animals presented to wildlife centers (Johnson 1986b). Reasons for presentation include confirmed or presumed death of parents, nest destruction, and fear that an outdoor domestic cat will attack a fledgling bird (Johnson 1986b; Duerr and Purdin 2007). The term "fledgling" typically refers to an altricial bird that has left the nest but is not yet independent of its parents (Orendorff 1997). American robins (*Turdus migratorius*) are a particularly populous passerine species common in suburban areas. According to Johnson (1986a), of the 200 American robins presented to Wildlife Rescue, Inc. (Palo Alto, California, United States) in 1986, approximately 60% were nestlings or fledglings according to the following classification of juvenile robins outlined in the same study: hatchlings: 0–4 days old; young nestlings: 5–9 days old; nestling–fledglings: 10–14 days old; fledgling–young adults: greater than 15 days old. American robins tend to present to wildlife centers as fledglings because people believe these active, but not fully flight-competent, juveniles have been abandoned or have fallen out of the nest (Howard 2007). Members of the public intending to help juvenile animals may take them away from their parents and, when possible, should instead be encouraged to return healthy birds to the wild (Johnson 1986b; Duerr 2007; Howard 2007). When the finders are unwilling or unable to return young birds to the wild, the birds are hand-raised by rehabilitators.

The process of hand-raising any juvenile songbird requires provision of proper diet and environmental conditions, prevention and treatment of injury and parasite infestation, and minimization of stress. Passerines, including American robins, are altricial; this means they hatch in a helpless state and are entirely dependent on their parents for care until they are several weeks old (MacLeod and Perlman 2001; Duerr 2007). As discussed by MacLeod and Perlman (2001), altricial nestlings have extremely high nutritional requirements because of their rapid growth rate. Such nestlings require a proper ratio of calcium to phosphorus (2:1) for bone growth and high levels of high-quality, animal-based protein for general growth, particularly of feathers. In addition, very young birds cannot thermoregulate so they must receive warmth, humidity, and frequent feeding of the correct diet (MacLeod and Perlman 2001). According to Orendorff (1997) the most common causes for mortality in juvenile songbirds are hypothermia, starvation, and dehydration.

At Willowbrook Wildlife Center (WWC; Glen Ellyn, Illinois, United States), hatchling and nestling American robins are housed in incubators and hand-fed a specially formulated slurry (Table 1) using a syringe. As the robins grow they are transitioned to larger, room-temperature housing and solid food. However, they are fed by hand until they are consistently eating on their own. This process is extremely labor-intensive, must be performed by skilled personnel, and consumes large quantities of potentially costly ingredients. The scientific literature provides an opportunity to share valuable information about how others in the rehabilitation community address these problems.

**TABLE 1. RECIPE FOR SLURRY FED TO NESTLING AMERICAN ROBINS *(T. MIGRATORIUS)* AT WWC.**

| AMOUNT | INGREDIENT |
|---|---|
| 1 C | ZuPreem Premium Ferret Diet, presoaked in 1-2/3 C water |
| 5 tblsp | Dried egg white |
| 2 tsp | Corn oil |
| 1/4 tsp (1.0 gm) | Avi-Era Bird Vitamins |
| 1/2 tsp (5 gm) | Plain yogurt, mixed in just before using |

A variety of approaches have been used in previous analyses of wildlife rehabilitation efforts including: retrospectively analyzing records from a single wildlife center (Hartup 1996); sending surveys to multiple centers (Gidner-Worthington 1997); and analyzing past records from multiple centers (Shine and Koenig 2001; Molony *et al.* 2007). Each study design has its own advantages and biases, but collecting data from wildlife rehabilitation centers is valuable overall because it can provide information about local species, threats to urban wildlife, and biological characteristics of poorly understood species (Shine and Koenig 2001). Analysis of wildlife rehabilitation data can also demonstrate the benefits of wildlife rehabilitation and increase public support for rehabilitation efforts (Gidner-Worthington 1997).

In analyzing what factors influence the success of wildlife rehabilitation for eight species commonly admitted to wildlife rehabilitation centers in England (European badgers [*Meles meles*], common blackbirds [*Turdus merula*], European hedgehogs [*Erinaceus europaeus*], red foxes [*Vulpes vulpes*], tawny owls [*Strix aluco*], pipistrelle bats [*Pipistrellus* spp.], European starlings [*Sturnus vulgaris*], and house sparrows [*Passer domesticus*]), one retrospective analysis (Molony *et al.* 2007) found that severity of injury was the most important factor influencing the likelihood of release across taxonomic groups while age and body weight were not significant. However, body weight was not examined in the passerine species (European starlings and house sparrows) included in that study because no data were available; therefore, the study was inconclusive as to whether weight influences release rate in these species.

The Molony *et al.* study specifically looked at factors that influenced rehabilitation success but did not discuss any changes (if any), based on their findings, to what patients were accepted (2007). However, one way some rehabilitation centers attempt to make the most-effective use of limited money, time, and space is by establishing minimum weight requirements for the juveniles of certain species to be admitted to the rehabilitation process. At WWC, weight limits exist for some mammal species (Eastern gray squirrels [*Sciurus carolinensis*], Eastern fox squirrels [*Sciurus niger*], northern raccoons [*Procyon lotor*], Eastern cottontails [*Sylvilagus floridanus*], and Virginia opossums [*Didelphis virginiana*]) but have not been established for any avian species. Weight limits can be controversial because they result in the exclusion of apparently healthy animals solely because they are statistically less likely to be successfully rehabilitated.

The purpose of this paper was to answer two questions: 1) What is the relationship, if any, between admission weight and the outcome of the rehabilitation process (released vs. died or euthanized) for juvenile American robins admitted to WWC? and 2) Can we propose a weight requirement for robin admission based on the admission weight and anticipated rehabilitation outcome?

## Methods

Data were extracted from the WWC electronic records for American robins admitted between 1 January 2008 and 31 December 2011. Only apparently healthy, juvenile (nestling and fledgling) robins admitted to the WWC rehabilitation system were included in the study. On presentation to WWC all animals received a physical exam by a veterinarian or Animal Care staff. A robin was deemed apparently healthy if this physical exam did not reveal any health problems; further diagnostic tests, such as blood tests or fecal examination, were only performed if warranted based on the history or physical exam. Robins were excluded from the study if they died before they could be examined for admission, if they were euthanized based on the initial exam, if they were returned to the wild with the finder, if they were classified as injured on

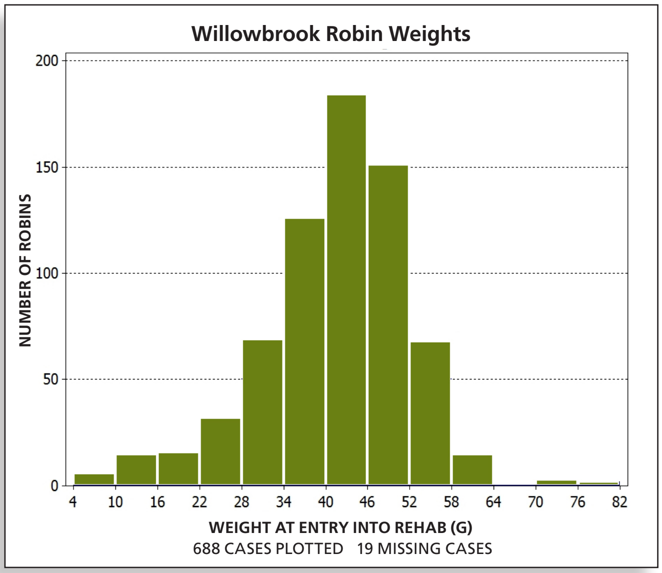


**FIGURE 1.** Histogram of admission weights of American robins *(Turdus migratorius)* admitted to Willowbrook Wildlife Center, 2008–2011.

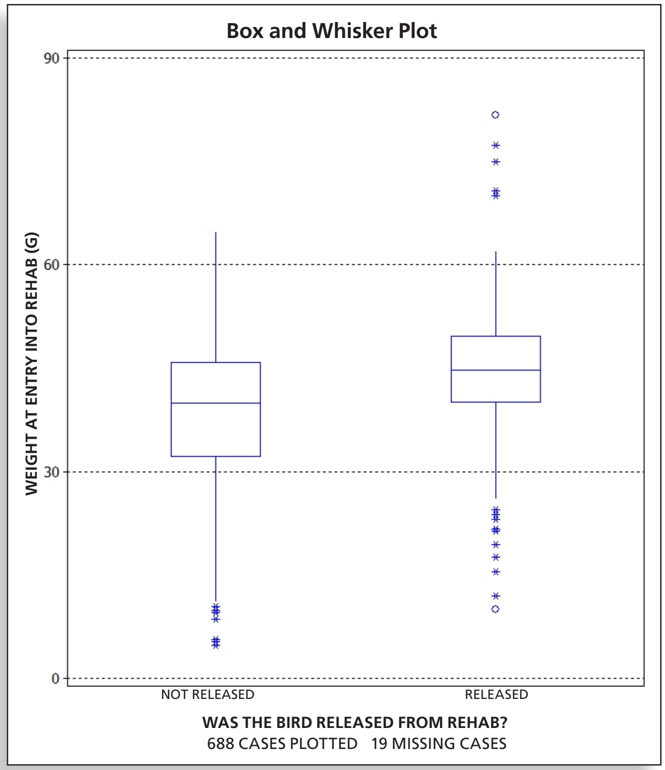


**FIGURE 2.** Box-and-whisker plot of admission weights of American robins *(Turdus migratorius)* admitted to Willowbrook Wildlife Center between 2008 and 2011. Data for birds that were ultimately released are displayed on the right side and data for birds that were not released (died or were euthanized during the rehabilitation process) are on the left side. Asterisks and circles indicate outlier data points.

initial physical exam, or if they had no disposition recorded in their record.

We used a Wilcoxon rank-sum test (2-sided; $P = 0.05$ required for significance) to compare admission weights between study robins that were and were not released to assess the relationship between admission weight and rehabilitation outcome. We conducted a receiver operating characteristic (ROC) curve analysis of study robin weights to determine whether we could use admission weight to predict whether a bird would be released. All statistical analyses were performed using Statistix™ 9 (Analytical Software 2008; Tallahassee, Florida USA), with the exception of the ROC curve, which was created using MedCalc™ 11.6.1.0 (F. Schoonjans ©2011; Mariakerke, Belgium).

## Results

A total of 688 American robins, each with a single corresponding admission weight, were included in the study. The median admission weight was 42.1 g, and 66.6% of study robins weighed between 32 g and 52 g at admission (Fig. 1). Overall, 47% (322/688; 95% confidence interval 43–51%) of study robins were released following rehabilitation. The distribution was non-Gaussian (Shapiro-Wilk normality test; $P < 0.0001$) so we used nonparametric methods. The median admission weight for study robins that were released (45 g, $n = 322$) was significantly greater than for those that were not released (died or were euthanized) (40 g, $n = 366$; $P < 0.0001$; Fig. 2). Although Figure 2 shows potential "outliers" based on purely statistical criteria, all weights were considered biologically reasonable and no weight was deleted from analysis.

The ROC curve, used to help identify a potential weight limit for admitted robins (Fig. 3), had an area under the curve (AUC) of 66.3% which was significantly different than the null-value

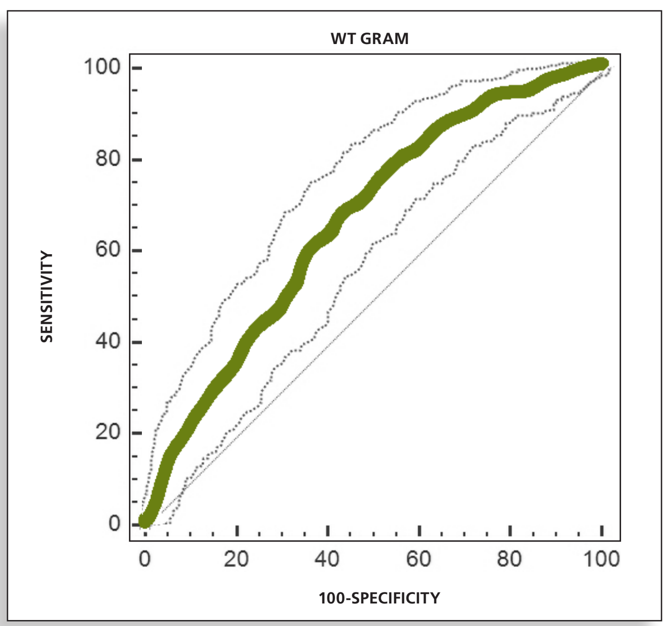


**FIGURE 3.** Receiver operating characteristic (ROC) curve for release versus admission weight of American robins *(Turdus migratorius)* rehabilitated at Willowbrook Wildlife Center, 2008–2011.

AUC = 50% ($P < 0.0001$). However, there was no clear inflection point, so a desirable cut-off value for admission weight was not obvious.

## Discussion

The 47% release rate for healthy juvenile American robins included in this study is similar to the 52% release rate reported by Johnson (1986a) for young robins at Wildlife Rescue, Inc. (Palo Alto, California, USA). The median admission weight (42.1 g) for study robins, as well as the median admission weights for released (45 g) and nonreleased (40 g) study robins, was less than but similar to the fledgling weight for robins (48–50 g) reported by Howard (2007). Based on a growth curve for juvenile American robins created by Johnson (1986a), the median weights of our study population are typical of robins between 5 and 8 days of age, which corresponds to the young nestling period (Johnson 1986a).

There was a statistically significant difference of 5 g between the average admission weight of study robins that were ultimately released and those that were not; i.e., the released robins weighed more at admission. Previous studies have also found a positive association between juvenile weight and survival in passerines (Magrath 1991; Ringsby *et al.* 1998), although these studies were conducted in the wild rather than in the rehabilitation setting. Although 5 g is 11.9% of the median admission weight for our study robins and would be a significant difference between juvenile robins of the same age, a growth curve for juvenile American robins created by Johnson (1986a) suggests that robins at the young nestling stage gain 5 g in a 12- to 24-hr period. Thus, the heavier birds in our study may have been older, and age rather than body weight may have increased their likelihood of release. Our study design did not control for potential confounding factors such as age, immune system development, body condition, and hydration status, all of which would impact a bird's ability to survive rehabilitation. Thus overall, despite statistical significance, a clear correlation between admission weight and release is not supported.

To interpret the ROC curve in this situation, it is necessary to provide a further definition of the terms being used. We are attempting to use admission weight to test for the probability that a robin will be released, such that robins with admission weights below a given cut-off value are less likely to be released while those above that weight are more likely to be released. The sensitivity of this test is the probability that a released animal will have had an admission weight above this weight cut-off (a "positive" result); the specificity is the probability that a nonreleased animal will have had an admission weight below the weight cut-off (a "negative" result).

When considering the use of weight limits for admission to a rehabilitation program, it is important to realize that if a cut-off were used, false positives (birds above the weight limit that are not releasable) would waste resources while false negatives (birds below the weight limit that would be released if rehabilitation were attempted) would be unnecessarily euthanized. It would be the choice of individual rehabilitators whether to or not to use limited resources on birds that are unlikely to survive to successful release. In wildlife rehabilitation, it may be desirable to minimize false negatives by maximizing sensitivity with a lower weight limit (taking a cut-off from closer to the upper right of the ROC curve in Fig. 3). However, high sensitivity comes at the cost of reduced specificity, so there will be more animals admitted that have a lower probability of release. For example, given this dataset, in order to rehabilitate 80% of the robins that were theoretically going to be releasable, the cut-off weight limit would be 38.2 g—which would mean 56% of the robins accepted for rehabilitation would not be successfully rehabilitated. (The intersection of 80% sensitivity on the Y-axis and 56% false negatives on the X-axis can be seen on Fig. 3; the fact that this corresponds to the cut-off of 38.2 g is based on data not shown.) If a rehabilitator chooses to set a weight limit for admission of a species into a rehabilitation program, he or she must determine what success rate is acceptable and whether it is acceptable to euthanize animals solely because they have a reduced chance of eventual release. Such decisions would likely vary by rehabilitator and by season depending on factors such as current patient load and abundance of particular species.

## Conclusions

Although the robins in our study that were released weighed an average of 5 g more on admission than did the study robins who died or were euthanized (thus not released), and although the ROC curve of admission weights was statistically significant, there was no clear cut-off for admission weight to use as a criterion for attempting American robin rehabilitation in the future. This indicates that admission weight is not conclusive for predicting release success in this species and should not be used in the rehabilitation setting to determine which robins are admitted for care. Other factors may be better predictors of rehabilitation outcome in robins, and additional studies are necessary to determine these factors. Further studies are also necessary to compare the effectiveness of weight as a predictor of rehabilitation success for other species of songbirds.

## Acknowledgments

Willowbrook Wildlife Center is an education and wildlife rehabilitation facility operated by the Forest Preserve District of DuPage County, Illinois. Willowbrook's mission is to provide rehabilitation to native and passing-migrant wildlife of DuPage County and to educate the public on the ecosystems current and native to the western suburbs of Chicago, Illinois. The authors acknowledge Willowbrook and the Forest Preserve for granting permission to use the data presented in this paper. Particular thanks go to the staff and volunteers at Willowbrook for their wildlife rehabilitation efforts and personal support, without which this paper would not have been possible.

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## About the Authors

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### Trends in Numbers of Petrels Attracted to Artificial Lights Suggest Population Declines in Tenerife, Canary Islands

A. Rodríguez, B. Rodríguez, and M. P. Lucas
*Ibis* 154(1): 167–172. 2012.

The secretive breeding behavior of petrels makes monitoring their breeding populations challenging. To assess population trends of Cory's shearwater *Calonectris diomedea*, Bulwer's petrel *Bulweria bulwerii*, and Macaronesian shearwater *Puffinus baroli* in Tenerife from 1990 to 2010, we used data from rescue campaigns that aimed to reduce the mortality of fledgling petrels attracted to artificial lights as proxies for trends in breeding population size. Despite increases in human population size and light pollution, the number of rescued fledglings of Cory's shearwater and Bulwer's petrel increased and remained stable, respectively, whereas numbers of rescued Macaronesian shearwaters sharply declined. In the absence of more accurate population estimates, these results suggest a worrying decline in the Macaronesian shearwater's breeding population. On archipelagos worldwide, thousands of fledglings of different petrel species are attracted to artificial lights during their first flights from nest-burrows to the sea, a phenomenon called "fallout." Grounded birds are vulnerable to starvation, predation, dehydration, and collision with vehicles. Rescue campaigns have been carried out in many places, and most of the rescued birds (>90%) are later released into the wild. The Canary Islands are an important breeding area for petrels in the northeastern subtropical Atlantic. At least seven petrel species (including shearwaters and storm petrels) breed regularly in the archipelago. Tenerife Island is the largest, highest, and the second-most inhabited (over 900,000 inhabitants) of the Canary Islands and is home to six breeding petrel species. There are no long-term monitoring programs on the Canary Islands to detect population trends of petrels. We used data from rescue campaigns to evaluate the population trends of the three most-common petrel species involved in fallout on Tenerife: Cory's shearwater *Calonectris diomedea*, Bulwer's petrel *Bulweria bulwerii*, and Macaronesian shearwater *Puffinus baroli* (formerly little shearwater *Puffinus assimilis*). Here, we report the number of rescued fledglings of these three petrel species during 21 years on Tenerife, Canary Islands and use these to assess population trends and propose appropriate conservation measures.


Magellanic penguin chick begging for food *(Spheniscus magellanicus).*

### Survival and Movements of Magellanic Penguins Rehabilitated from Oil Fouling Along the Coast of South America, 2000–2010

V. Ruoppolo, R. E. Thijl Vanstreels, E. J. Woehler, S. A. Rodríguez Heredia, A. Corrado Adornes, R. Pinho da Silva-Filho, R. Matus, C. Poleschi, K. Griot, C. K. Miyaji Kolesnikovas, and P. Serafini. *Marine Pollution Bulletin* 64(7): 1309–1317. 2012.

Oil pollution is a significant conservation concern. We examined data from six institutions along the coast of South America: Emergency Relief Team of the International Fund for Animal Welfare, Fundación Mundo Marino, Centro de Recuperação de Animais Marinhos, Natura Patagonia, Associação R3 Animal, and Mar del Plata Aquarium and data from resightings in Argentina, Brazil, Chile, and the Falkland–Malvinas Islands. From 2000 to 2010, 2,183 oiled Magellanic penguins were rehabilitated as part of the routine activities of these institutions or during emergency responses to eight oil spills in which they were involved; all rehabilitated penguins were flipper-banded and released. Since their release, 41 penguins were resighted until 31 December 2011. The results demonstrate that, when combined with other prevention strategies, the rehabilitation of Magellanic penguins *(Spheniscus magellanicus)* is a strategy that contributes to the mitigation of adverse effects of oil spills and chronic pollution to the species.

### The Post-Release Fate of Hand-Reared Orphaned Bats: Survival and Habitat Selection

M. T. Serangeli, L. Cistrone, L. Ancillotto, A. Tomassini, and D. Russo. *Animal Welfare* 21(1): 9–18. 2012.

Although bats are frequently admitted to rescue centers—mainly as orphans—very little information is available on their survival after release. Our study answered the following questions: 1) do hand-reared bats survive over a short time; 2) which activities and habitat selection do they exhibit; 3) are bats loyal to the release area; and 4) are they able to join local colonies? We radio-tracked 21 hand-reared *Pipistrellus kuhlii* over a 2-yr period released on a site that differed from that where they were rescued. At the study site, they were provided with the same bat boxes used in the rehabilitation room. Nineteen bats were confirmed to survive, stay in the area, and actively forage over 4–14 days. Fourteen day-roosts in buildings (nine of which hosted a local colony) were used by 12 subjects. Bats travelled less than 5 km in total each night; their most frequent activity was night roosting followed by foraging and commuting. We recorded typical foraging behavior, including hunting around street lamps at sites exploited by many conspecifics. A comparison of habitats available within individual home ranges with those within the study area showed that urban areas, riparian vegetation, and farmland were equally important and preferred to woodland. When the foraging time spent in each habitat was compared with habitat composition within individual home ranges or within the study area, urban sites were preferred for foraging over all other habitats, followed by farmland and woodland and, finally, riparian vegetation. Overall, we showed that hand-raised orphaned *P. kuhlii* may readily adapt to environments they are not familiar with, exhibit a high short-term survival, and select key resources in the release area, provided appropriate rehabilitation and training techniques are adopted.

### Further Evidence for the Post-Release Survival of Hand-Reared, Orphaned Bats Based on Radio-Tracking and Ring-Return Data

A. Kelly, S. Goodwin, A. Grogan, and F. Mathews. *Animal Welfare* 21(1): 27–31. 2012.

We recently used radio-tracking to demonstrate short-term, post-release survival of five orphaned, hand-reared pipistrelle bats. Here, we present further evidence of short-term, post-release survival and also demonstrate longer-term survival using resighting data of ringed common (*Pipistrellus pipistrellus*) and soprano (*Pipistrellus pygmaeus*) pipistrelle bats. Ten bats (five common and five soprano pipistrelles) were radio-tracked for between 1–10 days. Three of these were retrieved after 1, 2, and 4 days, respectively. In addition, five of the 39 (13%) ringed bats returned to their release boxes between 38 and 1,389 days after release, at least two of which survived over the winter in the wild. A sixth ringed bat was retrieved 27 days after release after becoming trapped in a house. We also identified potential barriers to successful rehabilitation. Two of the ten bats radio-tracked in the current project became trapped within buildings and another bat had to be retrieved following entanglement with debris. We therefore recommend that attention be paid to giving bats the opportunity, prior to release, in identifying and using small exit holes similar to those found in buildings and loft spaces. We also recommend allowing bats to self-release following prolonged pre-release flight training in a large flight cage situated in suitable bat habitat.



**Soprano pipistrelle bat** *(Pipistrellus pygmaeus).*

### Diagnosis, Treatment, and Outcomes for Koala Chlamydiosis at a Rehabilitation Facility (1995–2005)

J. E. Griffith and D. P. Higgins. *Australian Veterinary Journal* 90(8): 1–7. 2012.

Rehabilitation of wildlife in Australia is a high-profile activity involving tens of thousands of wildlife cases annually and large investments of time, effort, and money. Despite this, the few published studies on rehabilitating, hand-rearing, or translocating wildlife in Australia frequently report poor success. In contrast with most species, rehabilitation of koalas for several conditions appears to be relatively successful and, importantly, subsequent breeding of rehabilitated koalas can match that of wild controls. Breeding, however, is adversely affected by chlamydiosis, a common infectious disease of koalas. Koalas admitted with clinical signs consistent with ocular chlamydiosis (discharges, conjunctival and corneal inflammation) or urogenital tract disease (cystitis, incontinence, and urine scald, known colloquially as “wet bottom”) account for approximately 20% of all admissions, second only to trauma, to the hospital of the Koala Preservation Society of New South Wales (the Koala Hospital) in Port Macquarie. Although treatment regimens differ among koala rehabilitation centers throughout Australia and, despite the importance of reliable treatment to individual animals and their recipient populations, few studies exist regarding regimens' effectiveness in eliminating chlamydial disease or chlamydial shedding or ensuring the breeding success of koalas after release. Medical records have been collected at the Koala Hospital since the 1970s and comprise a data set sufficient to permit analysis of the re-presentation of permanently identified koalas as an indicator of the survival and breeding success of treated koalas, similar to passive resighting methods used with owls *(Tyto alba*, i.e., rings) and humpback whales (*Megaptera novaeangliae*, i.e., photographs of tail flukes). In the present study, we examined records from a cohort of koalas with external clinical signs consistent with chlamydial disease admitted to the Koala Hospital between 1995 and 2005. The aim was to document the most-recent methods of diagnosis and treatment used at this facility, assess their effect on animal recovery and post-release survival, and highlight some issues relevant to the management of wildlife care in general that have potential significance to animal welfare and disease ecology.

### Perceptions of Moose–Human Conflicts in an Urban Environment

A. M. H. McDonald, R. V. Rea, and G. Hesse. *Alces* 48(1): 123–130. 2012.

Urban expansion produces obvious and deleterious ecological effects on wildlife habitat. Land development plans continue to be approved in Prince George, British Columbia, both within and on proximate land that is occupied by moose (*Alces alces*). We surveyed 100 residents of Prince George to determine how they perceive potential conflicts with moose and compared those perceptions with available local data. The majority (~75%) indicated that there were <50 moose–human encounters within Prince George in any given year; however, 222 moose-related reports occurred from April 2007–March 2008. This discrepancy indicates that the public probably underestimates both the presence of moose and moose–human conflicts in Prince George. We did not find that outdoor enthusiasts were more knowledgeable than others about managing moose–human conflicts, suggesting that broad public education and awareness programs are warranted. Understanding how to respond to moose, and developing a "Moose Aware" program, were two suggested strategies to reduce conflict. The vast majority of residents (92%) enjoy moose and want moose to remain part of the Prince George environment; only 9% were in favor of euthanasia or sharpshooting to resolve conflicts. Because 40% indicated that the best option was leaving moose alone, managers will need to develop more effective strategies to minimize and manage moose–human conflicts.

### The Altruism-Empathy-Perspective Connection: A Case Study of Human–Wildlife Interactions at Chintimini Wildlife Rehabilitation Center, Corvallis, Oregon

K. S. Freed and J. A. Hale. *Oregon State Honors College Thesis* 13 April 2012. http://hdl.handle.net/1957/28741

In the realms of psychology and sociology, two new theoretical models have arisen to describe the forces influencing altruistic human behavior. The first is the Empathy–Altruism Hypothesis (EAH) by C. D. Batson. The second is the Conceptual Continuum of Altruism (CCA) by K. R. Monroe. Both models have proven to be highly useful in the study of altruistic behavior between human beings. However, to date, no investigations of altruistic human behavior towards other species have been conducted using these methodologies. Using a synthesis of both the EAH and CCA models, in conjunction with the New Environmental Paradigm (NEP) scaled questionnaire, the CWRC study evaluated the prediction that positive correlations would exist between the level of altruistic behavior exhibited by wildlife rescuers, the degree of empathy they demonstrated towards the wildlife they rescued, and their association with a world view supportive of this empathic response. The CWRC study generated a unique demographic data set for wildlife rescuers ($n$ = 407) as well as interview transcripts ($n$ = 40). Quantitative and qualitative data revealed that unique positive correlations existed between the level of altruistic behavior displayed by wildlife rescuers, the degree of empathic response they exhibited, and the strength of their association with a world view supportive of this empathic response.

### A Survey of Current Mammal Rehabilitation and Release Practices

A. J. Guy, D. Curnoe, and P. B. Banks. *Biodiversity and Conservation* 22(4): 825–837, 2013.

Mammal rehabilitation is carried out in hundreds of centers worldwide, requiring a large investment of time, personnel, and funds. Although there are numerous published studies focusing on post-release outcomes, few have discussed the methods employed in rehabilitation. As an important first step toward addressing this, data were collected directly from rehabilitation centers about their aims, methods employed, and assessment of outcomes. A survey of mammal rehabilitation centers was conducted with data collected in the form of responses to multiple-choice questions and written responses. Our results indicate a number of challenges including problems surrounding social-group formation, lack of predator-avoidance training, limited or no pre-release medical screening, release of animals exhibiting stereotypic behaviors, frequently short-term (<6 months) post-release monitoring, and with only a third of centers assessing the success of releases. Although many factors may influence the success of rehabilitation, improvements to monitoring and assessment are needed before the effects of any changes to protocols could be determined. Extended post-release monitoring and thorough assessment should be a part of any future mammal rehabilitation projects. With a view to improving the rehabilitation phase, we have developed a decision tree to assist the assessment of mammals at each stage of the rehabilitation process.

CONTINUED ON PAGE 29

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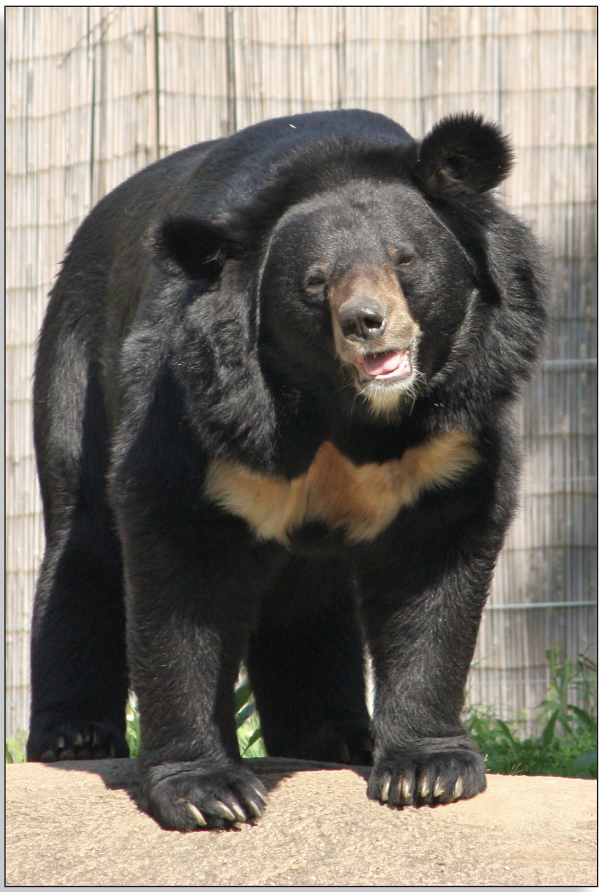
# Stereotypic Behavior and Secret Suffering

**By Deb Teachout, DVM**

I used to assume that if an animal was exhibiting a stereotypic behavior, they were experiencing poor welfare while their non-stereotyping cage mate was likely experiencing better welfare. Turns out I was partially right. Stereotypies are associated with past or present suboptimal aspects of the environment and seem to be restricted to captive animals, mentally ill or handicapped humans, and subjects given stimulant drugs (Hansen and Jeppesen 2005). Therefore, stereotypic behaviors are related to poor welfare in general. That part I got right. Recent research, however, has shown that sometimes the individual animals performing stereotypic behaviors actually have better welfare parameters than those animals that are not. That's the part I got wrong.

Stereotypic behavior has traditionally been defined as behavior which is repetitive, invariant, and lacking an obvious purpose or function. Think incessant pacing or swimming in a figure 8 or chewing on cage bars. Interestingly, science has revealed that some stereotyped behavior may actually serve a function and should be considered beneficial for the individual in terms of welfare. For example, calves raised for veal are often exclusively fed a milky diet that is highly unnatural, as calves of this age would normally start to forage on grass and ruminate. As a result of this environmental deprivation, some calves will spend hours a day in a stereotypical behavior known as "vacuum grazing" or "tongue rolling." They stick their tongues out and go through the motions of grasping a bunch of grass and pulling it into their mouth as they would do if they were permitted to forage or have access to grass (Fraser 2008). A research study revealed that the stomachs from calves that did not perform tongue rolling contained ulcers or ulcer scars while the stomachs from calves that did engage in persistent tongue rolling were ulcer-free. It is hypothesized that the action of tongue rolling stimulated the production of saliva, which helped buffer the acidity of the stomach, thus preventing stomach ulcers (Fraser 2008). The tongue rolling calves also exhibited a lowered heart rate in comparison to the non-stereotyping calves, suggesting that the behavior also induced a measure of calm in these animals. In this example, stereotypic behavior did serve a function and, therefore, improved welfare.





Asiatic black bear *(Asianursus thibetanus)*.

Another example involves a study of 290 fur-farm mink, where 75% of the population performed stereotypic behaviors such as pacing, circling of the cage, and gnawing the bars while 25% did not. In a stick test, a man entered a stick through the wire netting of the cage door and the mink fled from the stick, attacked it violently with teeth and claws, or explored it quietly by sniffing and soft manipulation. The stereotyping mink were more explorative and confident. The quiet, non-stereotyping mink showed excessive fear, aggression, and anxiety—which are considered aversive mental states and among the most direct signs of poor welfare (Hansen and Jeppesen 2005). These unanticipated results suggested that the stereotyping animals had likely discovered ways to calm themselves and provide some self enrichment while the non-stereotyping animals were actually suffering more.

From an environment where there are stereotyping and non-stereotyping wild animals, are any of them suitable for release? A 2003 study in Thailand of 29 wild-caught bears found that time spent in captivity was significantly correlated with an individual's level of stereotypy. Mean individual bear frequencies of stereotypy ranged between 0% and 51% of all observations (Vickery and Mason 2003). Bears are particularly susceptible to development of stereotypy, likely related to their complex feeding behaviors and large home ranges in the wild. In the study, the bears that showed the highest frequencies of stereotypic behavior also showed the highest rate of abnormal learning behaviors. Stereotyping bears may not be good candidates for release, even if they are the most able to seemingly cope with their captive environment. Reintroduction programs are faced, therefore, with balancing the benefits of time spent in captivity for rehabilitation or pre-release training with the potential damage that captivity can exert in terms of behavioral deterioration. Poor survivorship is often attributed to behavioral deficiencies (Vickery and Mason 2003). In addition, because behavioral deficits can occur before the onset of stereotypy, even non-stereotyping bears may show low levels of abnormal learning behaviors (Vickery and Mason 2003). This is illustrated in this video: "Ting Ting, the Sun Bear—Stereotypic Behavior 2."

In conclusion, environments that induce stereotyped behaviors in any animals are likely to create welfare problems; but in those environments, there is evidence to assume that animals that do perform stereotypies are in some ways experiencing better welfare than those that do not. We can use the sheer presence of stereotypic behavior in animals to identify the worst captive environments because stereotypy does not happen without past or present environmental deficiencies. From the bear study, we infer that in cases of ultimate release, stereotypies might threaten success. ■

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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.*


**ABSTRACTS**


CONTINUED FROM PAGE 26


This could be easily adapted to create detailed species-specific models in the future.

### T-cell Responses in Oiled Guillemots and Swans in a Rehabilitation Setting

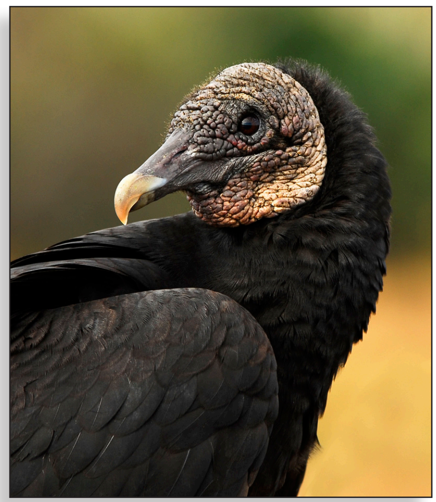
G. M. Troisi. *Archives of Environmental Contamination and Toxicology* (online edition). 20 March 2013.

Aquatic birds are commonly affected by oil spills. Despite rehabilitation efforts, the majority of rehabilitated common guillemots (*Uria aalge)* do not survive whereas mute swans *(Cygnus olor)* tend to have higher post-release survival. Polyaromatic hydrocarbons (PAHs) present in crude oil and diesel are immunotoxic in birds,affecting cell-mediated responses to immunogens. Because it is a target of PAH toxicity, T-lymphocyte response to controlled mitogen administration (phytohemagglutinnin test) was investigated in a scoping study as a potentially useful, minimally invasive *in vivo* test of cell-mediated immunity. The test was performed on 69 mute swans and 31 common guillemots stranded on the Norfolk and Lincolnshire coastline and inland waterways in England (U.K.) either due to injury or contamination with crude or diesel oil. T-lymphocyte response was significantly decreased in swans with greater oil scores. T-lymphocyte responses were also decreased in guillemots but this finding was not statistically significant.

### *Mycoplasma Corogypsi*-Associated Polyarthritis and Tenosynovitis in Black Vultures *(Coragyps atratus)*

A. J. Van Wettere, D. H. Ley, D. E. Scott, H. D. Buckanoff, and L. A. Degernes. *Veterinary Pathology* 50(2): 291–298, 2013.

Three wild American black vultures *(Coragyps atratus)* were presented to rehabilitation centers with swelling of multiple joints including elbows, stifles, hocks, and carpal joints and of the gastrocnemius tendons. Cytological examination of the joint fluid exudate indicated heterophilic arthritis. Radiographic examination in 2 vultures demonstrated periarticular soft tissue swelling in both birds and irregular articular surfaces with subchondral bone erosion in both elbows in one bird. Prolonged antibiotic therapy administered in two birds did not improve the clinical signs. Necropsy and histological examination demonstrated a chronic lymphoplasmacytic arthritis involving multiple joints and gastrocnemius tenosynovitis. Articular lesions varied in severity and ranged from moderate synovitis, cartilage erosion, and fibrillation to severe synovitis, diffuse cartilage ulceration, subchondral bone loss or sclerosis (or both), pannus, synovial cysts, and epiphyseal osteomyelitis. No walled bacteria were observed or isolated





American black vulture *(Coragyps atratus).*

from the joints. However, mycoplasma polymerase chain reactions were positive in at least one affected joint from each bird. Mycoplasmas were isolated from joints of one vulture that did not receive antibiotic therapy. Sequencing of 16S rRNA gene amplicons from joint samples and the mycoplasma isolate identified *Mycoplasma corogypsi* in two vultures and was suggestive in the third vulture. *Mycoplasma corogypsi* identification was confirmed by sequencing the 16S-23S intergenic spacer region of the mycoplasma isolates. This report provides further evidence that *M. corogypsi* is a likely cause of arthritis and tenosynovitis in American black vultures. Cases of arthritis and tenosynovitis in New World vultures should be investigated for presence of *Mycoplasma* spp., especially for *M. corogypsi.* ■

# TAIL END



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**Sooty tern chicks *(Onychoprion fuscatus)* use a black-footed albatross chick *(Phoebastria nigripes)* as shade.**

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