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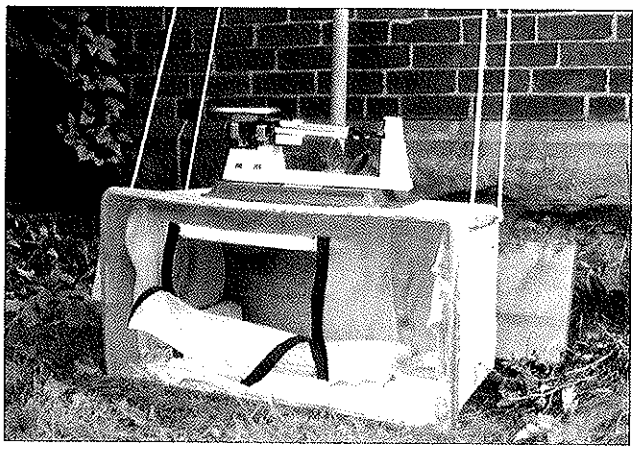
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ABOUT THE JOURNAL . . .

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 quarterly publication, rehabilitation courses offered in numerous locations, and an annual conference, IWRC works to disseminate information and improve the quality of care provided to wildlife.

ON THE COVER: The intriguing rock hyrax (*Procavia capensis*). [PHOTO: Mara S. Kraemer]. BELOW: A hackbox, used in the prerelease monitoring of four rehabilitated bats. [PHOTO: Sean Butler]



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EDITORIAL

Think Globally, Act Locally

Think globally, act locally. It's time to take this often-heard sentiment to heart and apply to our lives. In wildlife rehabilitation, we have the animals in front of us—*in our care*—to think about, but we cannot ignore the larger picture of wildlife issues worldwide. From the human-animal conflicts that are the direct result of our seemingly shrinking planet to the countless animals caught in the crossfire of international conflict, from the inhumane conditions under which animals are illegally smuggled from country to country, to the economic realities that *encourage* and *allow* this illegal wildlife trade to exist, we need to educate ourselves about the impact of global political and economic turmoil on wildlife everywhere.

In the United States, the terrorist attacks on the World Trade Center and the Pentagon have had far-reaching effects on nonprofits of all stripes—including wildlife organizations. Last November the *New York Times* reported that "The faltering U.S. economy and the effects of the September 11 terrorist attacks are causing a shift in the charity landscape as many new nonprofits struggle to survive, while others adjust fundraising approaches and refocus on their missions."

During the late 1990s, many U.S. nonprofit organizations benefited from increased donations as the economy and stock market continued to climb. Donations from foundations, corporations, and individuals were at an all-time high. However, as a result of the recent economic downturn, many nonprofits have seen their funding slide; many fear they will not survive the crunch. In some cases, fundraising events and activities are bringing in far less than expected; in others, major contributors are reneging on their pledges.

It's hard to fully assess the damage of the current economic and giving climate. Many professional fundraisers believe that donations made in the aftermath of the September 11 attacks were made *in addition to* their donors' usual giving. The impact of the economic downturn is perhaps harder to assess. A recent poll released by Independent Sector , a coalition of nonprofit organizations, foundations, and corporations dedicated to strengthening not-for-profit initiatives and citizen action, found that one in ten Americans indicated they would completely stop their giving if the economy worsened while an equal number said they would greatly reduce their giving.

What can we do? Many in the fundraising field are advising organizations to go back to the basics and focus on their missions. H. King McGlaughon, director of the Center for Philanthropy and Nonprofit Management at Merrill Lynch, advises nonprofits to "talk [to donors and prospective donors] directly about what you do and the value of your programs to the community." For wildlife centers both large and small, the message once again is *education*. We need to clearly, consistently, and frequently let our communities know just what we do and why it is so important that we continue to do it. Fundraising and education can seem at best an inconvenience when there are needy animals in front of us, but now, especially, we cannot afford the luxury of ignoring them.

—Marianne Skoczek
Editor

NOTE: The Foundation Center is assessing the longer-term impact of both the 11 September 2001 terrorist attacks and the U.S. economic downturn on philanthropic giving. To have your organization's experiences included in this national survey, complete their questionnaire, available at http://www.crisisresponse@fdncenter.org.

On Vitamin C for Birds, Hedgehog Rehabilitation

Could you explain the role of vitamin C in the diet of wildlife? I know about the benefits when I take it, but I thought that most animals make their own vitamin C. Why do the birds I rehab need it? Does it also boost their immune system, as it does for us?

—Concerned Rehabber

You're right that many animals make their own vitamin C (ascorbate), at least to some extent. In evolution, the ability to synthesize vitamin C arose with terrestrial vertebrates, and, in some cases, the ability was then lost with further evolution. So invertebrates and fish cannot make ascorbate, but amphibians, reptiles, most birds, and primitive mammals synthesize it in the kidney. Birds are very interesting. Passeriforms (including passerines, or songbirds) are among the most recent birds to evolve, and half of them have lost the ability to make vitamin C. Of the half that do make it, some make it in the kidney, some in the liver, and some in both organs. Most mammals synthesize ascorbate in the liver. However, higher primates, bats, guinea pigs, and possibly cetaceans have once more lost the ability to make vitamin C.

For many animals that do have a synthetic capacity, vitamin C remains conditionally essential. In a number of species of birds, studies show that ascorbate is not made in sufficient quantities during growth or at times of stress or illness. Thus, birds whose diets are supplemented with vitamin C during these times survive, whereas those with unsupplemented diets die. It is entirely possible that similar facts hold for mammals and other patients, as well.

Organochloride pesticide poisoning also increases the vitamin C requirement.

Vitamin C has been shown, in the above studies and many others, to play a variety of life-supporting roles. It does, indeed, boost the immune system and, in experimental conditions, it permits recovery from bacterial infections that are otherwise lethal. It also has well- understood roles in skeletal growth and the formation of connective tissue, crucial for young animals and for wound healing.

Since animals in rehabilitation are growing, ill, and/or injured—and we can assume that they are experiencing captivity stress as well—rehab diets should *always* contain vitamin C. A safe and effective dose is 500–1000 mg per kg of food.

—Astrid MacLeod and Janine Perlman
"Food for Thought" columnists

I read with interest Dr. Bunnell's paper on parasitic and bacterial pathogens in the hedgehog (The importance of fecal indices in assessing gastrointestinal parasite infestation and bacterial infection in the hedgehog [*Erinaceus europaeus*]. *J. Wildlife Rehab.* 24[2]).

—Richard Saunders, BSc, BVSc, MRCVS CertZooMed; Swaffham, Norfolk, UK

QUESTION 1. Which formulation of enrofloxacin (Baytril) did you use? You do not specify whether the 25 mg/ml or 50 mg/ml injectable form was used by injection, or the oral 2.5% or 10% form were used orally. That would enable the dose in mg/kg to be determined. Also, some anecdotal reports suggest that the injectable and oral forms given orally have different efficacy (usually suggesting that the injectable form works better). I am a bit concerned that the total dose in mg/kg is 25–50 mg/kg, as this is considerably higher than the 10–15 mg/kg that data sheets and anecdotal reports usually suggest, particularly at 2x daily dosing. While I accept that rapid metabolism of such drugs according to allometrically scaled doses, I would like to know if you feel that these doses give better results than lower ones, and whether you have noted any toxicity issues. I am not aware of cartilage deformities developing in small insectivores, as has been reported in dogs and horses, but there are reports in the U.S. of retinal damage resulting in permanent blindness in cats dosed at 25 mg/lb once daily, and I have heard anecdotal reports of this occurring in the the UK as well.

I tend to use the injectable form of Baytril (concentration not known as administered by my vet) when an animal first arrives, if it is in bad shape/weak, followed by the oral form for the rest of the week. The injectable form tends to be more effective with animals with gastrointestinal problems (resulting in impaired absorption of food/medication). No toxicity issues were noted. The dose administered is as given on the medication container:

Oral Baytril: 2.5%–0.3 ml 2x a day. I was told to administer 0.5 ml to a 500 g animal and others pro rata i.e., 0.3 ml twice a day to a 300 g animal.

QUESTION 2. Did you find any flukes in your samples? These seem very geographically localized, but do appear to be spreading in range.

I tended not to find flukes in fecal samples, but gave a Praziquantel injection when all else had failed or if the animal was having problems digesting/absorbing food.

QUESTION 3. Did you perform any bacterial sensitivity tests to decide upon bacterial choice? Did you try other antibiotics?

No bacterial sensitivity tests were performed to decide upon antibiotic choice, however, my veterinary practice told me that Baytril was by far the best antibiotic for use with hedgehogs. Septrin was only used as an alternative if an animal was failing or suffering from a chronic chest infection that was not responding to Baytril. I have been told (since publication of the paper) that Septrin can also be used as a treatment for *Isospora* spp.; this is a good alternative to a series of Bimalong injections as it eliminates the stress experienced by the hedgehog while being injected.

QUESTION 4. Did you trial Levamisole for *Crenosoma* and *Capillaria* therapy? Robinson found it more effective than Panacur, and more reliably administered as an injectable.

I have not done trials with Levamisole for *Crenosoma* and/or *Capillaria* therapy as I have always found Telmin to be very effective in this instance, much more so than Panacur. Sykes and Durrant also note that Telmin is more effective than Panacur in these circumstances.

—Toni Bunnell, University of Hull, U.K.

The Editors encourage readers to respond to the articles, columns, and other items in the Journal of Wildlife Rehabilitation. *Please direct general questions and comments to the Editor at runmuki@earthlink.net (USPS address on the journal's inside back cover). To respond to a specific article or column, please contact the author directly. (Letters may be edited for clarity and length.)*

Case Study: Care and Release of an Orphaned Big Brown Bat Pup (*Eptesicus fuscus*), Part III

by Edythe Butler

ABSTRACT: This is Part III of a three-part article on the rehabilitation and release of "Miss Peep," an orphaned big brown bat pup (*Eptesicus fuscus*) that came into care in Ottawa, Ontario, Canada, the day she was born. Part III describes the last 3.5 weeks in the flight tent and the release process for Peep and her tent mates: a mother bat and twin captive-reared youngsters. A hackbox is introduced into the tent, and once the bats are comfortable with it, it is transported to the release site at Peep's natal maternity colony roost. The four bats are confined there with food and water replenished daily for 1 week, and then the hackbox is opened for a "soft" release. The open hackbox is kept stocked with fresh mealworms for 2 months. Peep and the mother bat leave overnight the first night, but the twin youngsters do not and are retrieved the second night. Postrelease marking and tracking options—including banding and radio telemetry—are discussed, and the lightweight fluorescent fabric dots used by the author are described. Release strategies used by wildlife rehabilitators for captive-reared insectivorous bat pups in North America are also reviewed, and one divided hackbox technique used in Europe is described.

KEY WORDS: wildlife rehabilitation, Microchiroptera, big brown bat, *Eptesicus fuscus*, captive-reared bat pup release strategies, hackbox, postrelease tracking, fluorescent fabric marker

EDYTHE BUTLER is a home-based wildlife rehabilitator, licensed by the Ministry of Natural Resources in Ontario, Canada. She has rehabilitated small mammals since 1987.

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Introduction

This is Part III of a three-part article on the rehabilitation and release of "Miss Peep," an orphaned big brown bat pup (*Eptesicus fuscus*) in Ottawa, Ontario, Canada. Part I presented the intake circumstances for this newborn bat; reported on Peep's first 2 weeks in care, when she was housed in an incubator and hand-fed milk formula; provided brief natural history information about bats in general and big brown bats in particular; and outlined health precautions for wildlife rehabilitators. Part II covered the rehabilitation of this pup from 2 to 8 weeks of age, including weaning from formula to mealworms and transfer to a flight tent after first flight at 4 weeks of age. Three other big brown bats—a mother bat and her captive-reared twin youngsters—were introduced to the flight tent to condition them for release and to provide Peep with conspecific company. Part III follows Peep and her tentmates for the last 3.5 weeks of flight training. The addition of a hackbox in the flight tent and the "soft" release back to Peep's natal maternity colony roost is described, and postrelease tracking or marking options are discussed. Release strategies used for captive-reared insectivorous bat pups in North America are reviewed, and one divided hackbox technique used in Europe is also described. No postrelease data were collected that document for certain that Peep survived in the wild, but a few observations allow for optimism.

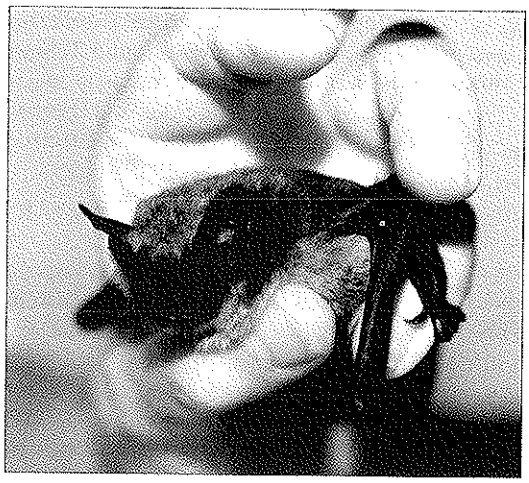
Statement of the Problem

An adult female big brown bat was noticed and rescued from a farmhouse veranda near Ottawa, Ontario, on 5 June 1999 due to the loud peeping of newborn twin pups clinging under her wings. Unfortunately, both the mother bat and the male pup died shortly after intake (the mother of a uterine infection and the pup of septicemia). The female pup, Peep, survived, however. She was hand-reared and introduced to three other captive big brown bats; all four bats were then prepared for a soft release back at Peep's natal maternity colony roost under the farmhouse eaves.

Methods

Releasing Miss Peep: 8 to 11.5 Weeks of Age (1–25 August 1999)

A few days into the effort of caring for Peep, the author's comfort level with this tiny, dusky-colored creature rose significantly, and concern that she might die (as her twin had) gave way to a focus on the fact that she had a potentially long life ahead.



MEAGAN BUTLER

FIGURE 1. Peep at 8 weeks of age, 31 July 1999, weighing 20.2 g. She has a forearm measurement of 45 mm and a body length of 7.62 cm (3 in). She now self-feeds on mealworms from a bowl and is housed in a flight tent with three other big brown bats. ***NOTE: Peep was admitted into care the day she was born, and her mother tested negative for rabies. The author did not wear gloves to handle this animal. Whether or not the animal's rabies status is known, this should not be taken as a recommendation to others.***

The longevity record in the wild for a banded big brown bat is 19 years from time of banding (Paradiso and Greenhall 1967 [cited in Tuttle and Stevenson 1982]), and one captive big brown male, taken into care as a young pup, was reported to be 22.5 years old in 1998 (Lollar and French 1998). Although preweaning mortality of big brown bat pups in the wild is low: 1–12% (Tuttle and Stevenson 1982 [cited in Altringham 1996]), newly volant (flighted) young are inexperienced, making them more vulnerable. Juvenile mortality in another insectivorous bat, the evening bat (*Nycticeius humeralis*), has been found to be lower in larger attic roosts where newly volant young could safely practice flight, than in enclosed roosts (Watkins 1972 [cited in Tuttle and Stevenson 1982]). Similarly, gray myotis (*Myotis grisescens*) young forced to travel much more than 1 km to forage suffer higher mortality (Tuttle 1976 [cited in Tuttle and Stevenson 1982]). One study reports an 80% mortality in first year female evening bats, based on numbers returning to study colonies at traditional maternity roosts in Missouri, but the study itself may have inadvertently influenced mortality (see banding discussion below), since each juvenile bat (caught by hand in the roost) was marked for identification with two reflecting bands on one wing and one numbered band on the opposite wing (Wilkinson 1992).

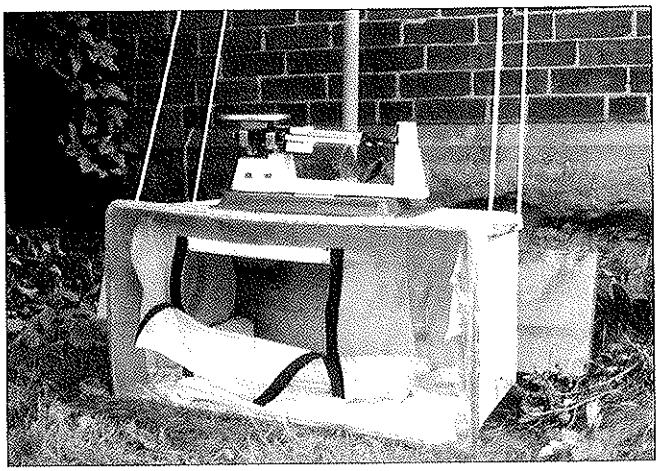
Captive-reared bat pups have been considered nonreleasable by some bat experts in North America (Barnard 1991), and the author considered the possibility that Peep might have to spend her life in captivity. However, over the past decade a few bat pup release studies have been published in North America. After reviewing this literature and communicating with rehabilitators who release captive-reared pups, the author became convinced it was possible to devise a workable release strategy for Peep and her tentmates (Appendices 1 and 2). One strategy reported in Europe described release of juvenile noctule bats (*Nyctalus noctula*). Albrecht and Helversen (1994 [cited in Barnard 1995]) placed unreleasable mother bats and their volant, captive-born youngsters in a release hackbox that was divided in two by a mesh wall. Mothers were placed in one side with no exit hole, and the young in the other side with an exit hole. The mesh divider allowed contact between mothers and juveniles. Four of the young bats were radio tracked and observed to gain flight experience, improve feeding strategies, and explore new feeding grounds. The young returned to the hackbox after foraging, and during the day they were retrieved and placed in the closed side of the hackbox with their mothers.

Postrelease Tracking or Marking

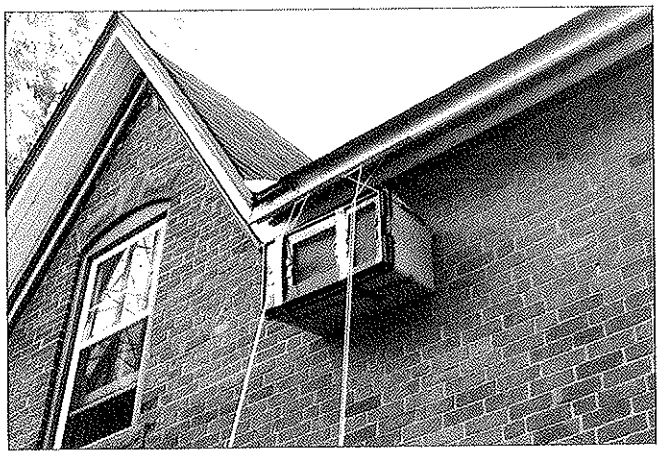
The author considered trying to track Peep and her tentmates postrelease using small 0.47 g radio transmitters glued onto their fur. The added weight should not be more than 3% of the bat's body weight, and such small transmitters met that criterion, since as release time approached the four bats weighed 17 g (twin youngsters), 25 g (Peep), and 30 g (mother bat). However, such telemetry devices are costly, fall off the bat in about 2 weeks, and a receiver is required in order to track them. Researchers will often lend receivers, but the author was unable to find one available in Ottawa.

Next, she considered banding, having been given samples of numbered metal U.S. Fish and Wildlife Service bands and

(continued on page 7)



SEAN BUTLER



SEAN BUTLER

FIGURE 2. The four bats were monitored and their food dish was refilled daily for the 7 days they were confined in the hackbox at the release site. To make monitoring the box a one-person job, four eye hooks were bolted to each top corner, and nylon rope fed through these hooks then up through the hooks on the roof and back down again, allowing one person to hoist the box up and down.

FIGURE 3. The hackbox was hung at the entry point to Peep's natal maternity colony roost under the eaves of a farmhouse that backed onto a small river. Big brown bats in Ontario often use human-made structures (attics or roof cavities) for maternity roosts and usually fly less than 1 km to feed (Altringham 1996). This small colony of about 20 individuals foraged each evening around the farmhouse and over a small river running approximately 200 m from the roost. The soft release process involved many evenings of monitoring, and the night sky was fantastic. Big brown bats have good night vision and can also see the stars (Hill 1984).

FIGURE 4A. EARLY P.M. (BEFORE FEEDING) WEIGHTS FOR 3 BIG BROWN BAT (*EPTESICUS FUSCUS*) YOUNGSTERS WHILE SELF-FEEDING IN A FLIGHT TENT AND HACKBOX

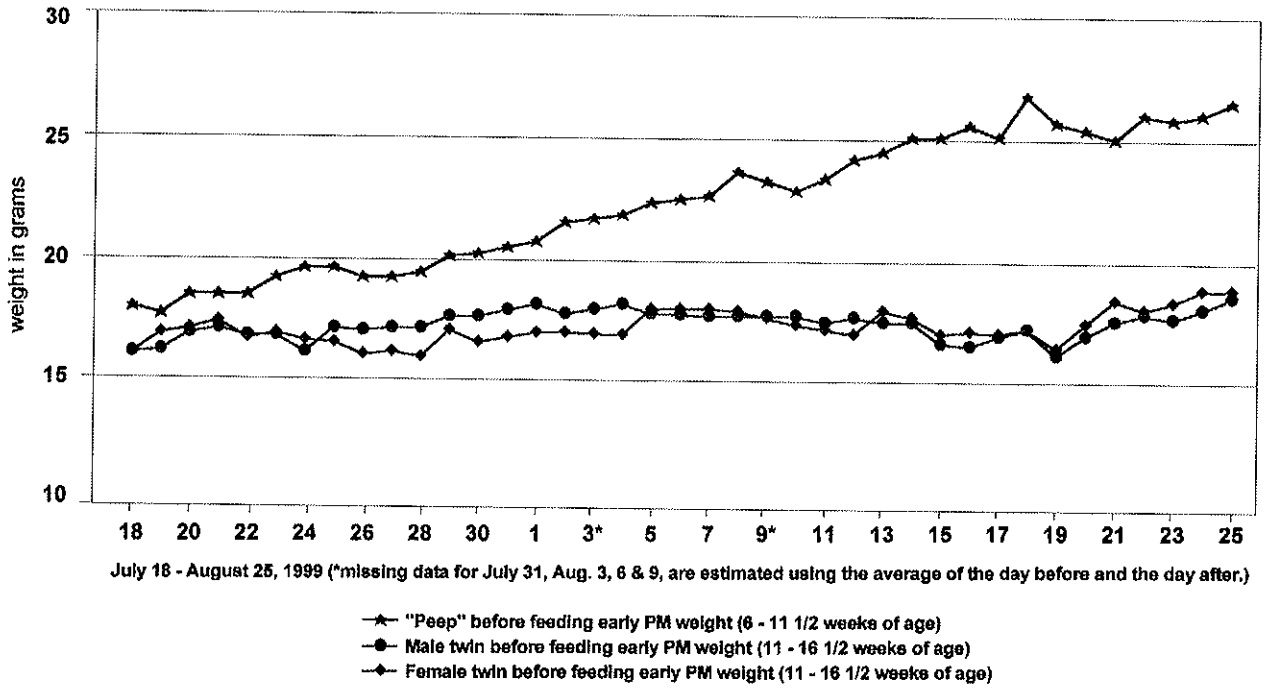
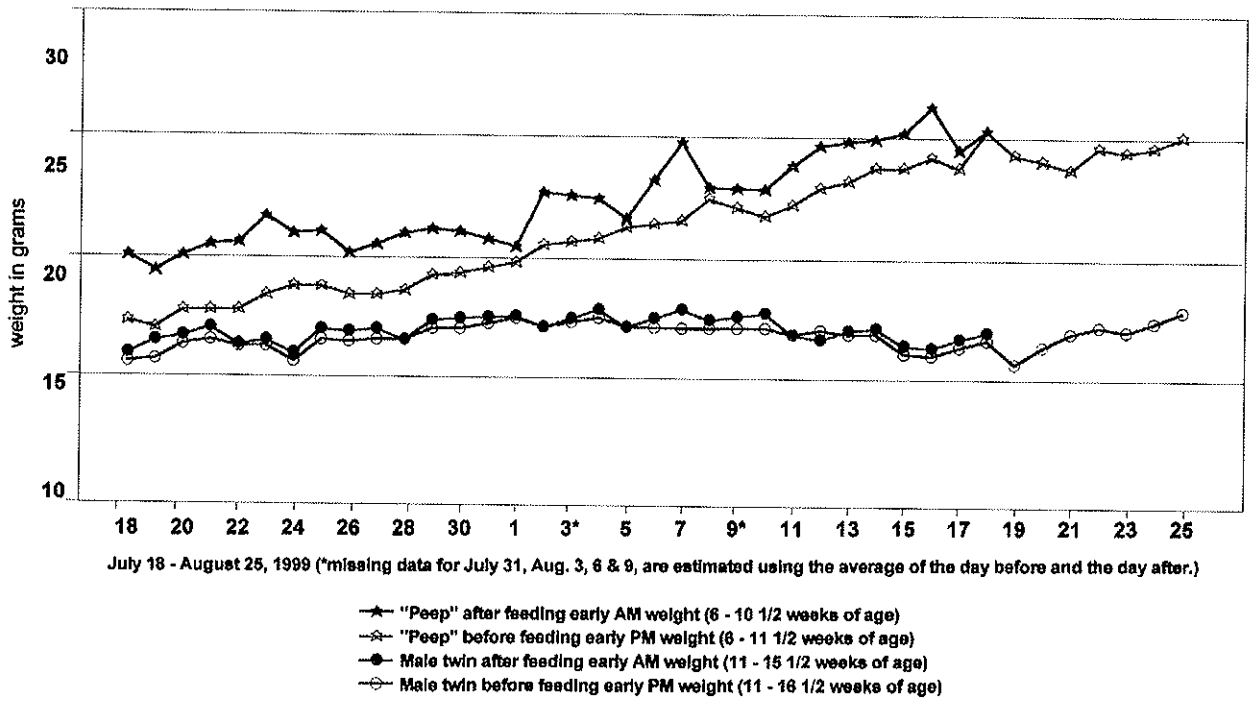


FIGURE 4B. WEIGHT FLUCTUATIONS FOR 2 BIG BROWN BAT (*EPTESICUS FUSCUS*) YOUNGSTERS WHILE SELF-FEEDING IN A FLIGHT TENT AND HACKBOX



Charts reflect data for 18 July–25 August 1999. Peep and the twins self-fed from a bowl of mealworms in the flight tent 18 July–11 August. The dish was then placed in a hackbox on a 1 m (3 ft) platform in the tent. Only Peep flew to it to self-feed. The twins were hand-fed 2–3 mealworms each A.M., and each lost 1 g over the next week. From 18–25 August the bats were confined to the hackbox at the release site and all self-fed overnight. The twins regaind the weight they had lost.

colored plastic split ring bands. The metal ones were relatively large, weighing about 0.2 g, and would have required careful filing to remove any rough or sharp edges. The plastic ones, although lighter, would also have needed to be modified by filing the gap wider and rounding the edges. Bat workers who use lighter metal alloy Lambourgne bands from England, weighing about 0.04 g (Stebbings 1987 [cited in Lollar and French 1998]), report they are safer for bats (Kemmerer 1999, pers. comm.; Winters 1999, pers. comm.). However, concerns about interfering even slightly with the inexperienced young bats' flight and the documented cases of bands causing life-threatening injury to bats (Lollar and French 1998, 230–31) decided the author against use of banding as a marking option. She would have tattooed the bats' ears (Lollar and French 1998), but she did not find anyone experienced in this procedure in Ottawa, and also suspected that a tattoo would not be easily visible on a big brown bat's black ears.

Temporary markers such as nontoxic fluorescent craft paint, nail polish, or colored cattle markers were then considered, but craft paint was not durable enough and quickly cleaned off fur by the bat; nail polish smelled obnoxious and was not visible from any distance; and although the waxy mark from the cattle markers stayed on fur well for about a week, it was only visible up close in good light. Since there was no access right into the maternity roost, the author had to hope to sight a marked bat from outside as it exited at dusk. The marking option she finally settled on was to glue paper-punch-sized pieces of a lightweight fluorescent fabric to the bats' fur, in hopes they would be visible in a flashlight beam as they emerged in the evening. One such marker did not register on the gram scale, but five together weighted less than 0.1 g. Each marker thus weighed less than 0.02 g, and since Peep could urinate 0.5 g and often drank 1 g or more, the author was confident these small dots would be an insignificant burden, and would fall off relatively quickly without causing a problem.

Release Concerns

During the period the bats were housed in the flight tent (8 July–18August), there were a couple of concerns other than how to mark them. First, the mother bat continued to need help feeding from the dish. This was not a real problem for release though, since she was a wild bat and already knew how to forage on the wing. Secondly, although all three youngsters learned to find the mealworm dish and happily self-fed overnight from it when it was placed in various locations on the floor of the tent or on low cloth-draped chairs (in retrospect all accessible by fluttering down or climbing to), once it was placed in a hackbox on a platform in the tent in early August in preparation for release, numbers of mealworms eaten, and A.M. weights indicated that only Peep was flying into it to access the food. The hackbox was made from a 116-liter plastic storage bin, lined with mesh (no-skid backing for throw rugs), and furnished with cloth roosts. The bin was laid on its side, the lid was removed and replaced with window screening, and a door was then sewn from screening and attached with 2.5 cm (1 in) wide velcro strips (Figure 2). The door was left off, and the hackbox was stocked with mealworms, a hamster water bottle, and a very shallow 6.4 mm (0.25 in) deep water dish.

The release decision was complicated by the fact that the twin youngsters were small and plump. By 11 August they weighted 17 g each. This sounds within the right range, however, they were only 57 mm (2.25 in) in body length and had forearms measuring 38 mm (1.5 in). Peep and the mother bat were both 76 mm (3 in) in length, with forearms of 45 mm (1.8 in) and weights of 25 g and 30 g, respectively. The author was unsure whether the twin youngsters were settling in to conserve energy for winter, and hence *unmotivated* to fly, or were *unable* to maneuver in flight well enough to fly into the hackbox. She decided to greatly reduce the number of mealworms she hand-fed them in the morning even if it appeared they had not eaten overnight. They gradually lost 1 g each over the next week, on a diet of 2 or 3 mealworms fed each morning. Okon (1979), studying the insect bat (*Tadarida nigeriae*), concluded that under natural conditions the level of nutrient stores of bats is a function of three principal factors, namely, the nutrient ratios of their food sources, their roosting behavior; and the bioenergetics of temperature regulation. The twin youngsters seemed to be roosting quietly (in mild ambient temperatures) staying relatively inactive, thus conserving their fat reserves (Figures 4A and 4B).

Despite these concerns, after delaying release for a week, on the morning of 18 August, the author glued a trial fluorescent fabric marker on Peep's chest fur with a tiny speck of SuperGlue, and later that day, all four bats were confined to the hackbox and transported to the farmhouse where the hackbox was hung under the eaves at the entry/exit point to the maternity colony. The bats were kept in the hackbox for 7 days with food and water replenished every day. During the first 3 days, the number of mealworms eaten and the bats' weights indicated that only Peep and the mother bat had eaten significantly overnight. The twin youngsters were hand-fed 8–15 mealworms each daily. However, the next 4 nights all four bats self-fed, and between 67 and 110 mealworms (in total) were consumed each night (Table 1).

Postrelease Observations (25 August–23 October 1999)

On release day, 25 August, Peep's chest marker from 18 August was still holding, and two new ones were glued to the fur on her back. Each of the other bats was marked similarly with two dots of fabric. Unfortunately, the release was a little late in August. Although the maternity colony was there on 18 August when the hackbox was hung, they had dispersed by release day. Nevertheless, five or six individual bats were still foraging each night around the farmhouse and roosting under the porch roof about 15 m (50 ft) from the hackbox.

When the hackbox was checked on 26 August, Peep and the mother bat were gone. The twin youngsters were still there, however, snuggled in their familiar cloth roost; 60 mealworms had been eaten overnight. When the male youngster fluttered to the ground after dark, he was grounded, and both youngsters were retrieved. The hackbox was restocked with 200 fresh mealworms on 26 August and again on 27 August, then not checked until 30 August. At that point there were lots of new bat droppings in the box, and 13 mealworms had been eaten over the 3 nights (27–29 August). None of the missing mealworms had been chomped in two or half-eaten, which was the inefficient dining style of the mother bat, so the author speculated that Peep may have eaten all 13. The next evening at

(continued on page 9)

TABLE 1. "MISS PEEP," A HAND-RAISED BIG BROWN BAT PUP (*EPTESICUS FUSCUS*) CARE SUMMARY: 8 TO 11.5 WEEKS OF AGE, 1–24 AUGUST 1999

Age (weeks)	Age (days)	Weight (grams)	Comment	Feedings
8	57–60	20.7–21.8	Peep and the two youngsters self-feed from dishes in the tent, but mother bat continues to need help and is placed in the dish to eat.	8 P.M.–7 A.M.: share of 50 mealworms left out each night + water
	61	23.3	Mother bat is transferred to her original caregiver. A 116-liter plastic storage bin hackbox is introduced into the tent on a platform ~1 m (~3 ft) off the floor. The three youngsters are placed in it overnight with the mealworm dish, water bottle, and cloth roosts. They all self-feed.	8 P.M.–7 A.M.: share of 50 mealworms left out and eaten from the hackbox dish.
9	65–67	22.6–23.3	The three youngsters are placed across the tent from the hackbox. Peep flies to it to eat overnight, but A.M. weights indicate the other three youngsters are not successful, and each is fed 3 mealworms in A.M.	8 P.M.–7 A.M.: 10–16 of the 50 mealworms left out are eaten each night.
	68	24.1	Mother bat is returned and placed in the hackbox to eat from the dish. The three youngsters are left across the tent with the hope that the mother bat will attract them to the box and their food. The next morning all four bats are across the tent hanging, but weights indicate only Peep has self-fed.	8 P.M.–7 A.M.: 17 of the 50 mealworms left out are eaten overnight.
10	70–73	25.0–25.0	Mother bat continues to be helped to feed from the hackbox each P.M. Peep self-feeds overnight, but the other two youngsters are not successful, and are hand-fed 2–3 mealworms each A.M.	8 P.M.–7 A.M.: 16 of the 50 mealworms left out are eaten each night.
	74–76	26.7–26.7	The bats are confined to the hackbox, and it is hung at the entry point to Peep's natal colony roost. Peep is marked with one dot of lightweight flourescent fabric, glued **(A)** to her chest fur. The dish is refilled with 200 fresh mealworms daily. Peep and mother bat self-feed, but weights indicate the twins do not eat much overnight.	~5 P.M.: 39–57 of the 200 mealworms left out are eaten each night the first 3 nights out. The twin youngsters are hand-fed 8–15 mealworms each day at ~5 P.M.
11	77–80	24.9–25.9	The bats are self-feeding the last 4 nights while confined to the hackbox at the release site.	~5 P.M.: 67–110 of the 200 mealworms are eaten each night.

(A) Flourescent fabric = FlashBack. Glue used was CrazyGlue, but it is not recommended as it caused skin irritation in one bat. Skin Bond® is recommended.

TABLE 2. "MISS PEEP," A HAND-RAISED BIG BROWN BAT PUP (*EPTESICUS FUSCUS*) RELEASE AT 11.5 WEEKS OF AGE ON 25 AUGUST 1999 POSTRELEASE OBSERVATIONS: 26 AUGUST–23 OCTOBER 1999

Date	Hackbox/Feeding Station	Comments
25 August	On release day the bats are each marked with two paper-punch-sized dots of lightweight flourescent fabric glued to their fur. The dish in the hackbox is stocked with 200 mealworms.	The hackbox is open and the bats are free to go, but none leave while the author watches until long after dark.
26 August	Overnight 60 mealworms have been eaten (25 August), and the dish is replenished with 200 fresh mealworms.	Peep and the mother bat have left, but the 2 youngsters are still in the hackbox. After dark the male flutters to the ground and both are taken back into care.
30 August	Over 3 nights, 13 mealworms have been eaten (27–29 August), and lots of new bat droppings are noted in the hackbox. The dish is refilled with 200 fresh mealworms.	Standing on a stepladder at dusk the next day, the author notes a "calm" bat in the crevice where five to six bats roost under the front porch roof. No positive ID is made, however.
7 September	No mealworms have been eaten over 8 nights (30 August–6 September), although the dish is refilled with 200 fresh mealworms each evening.	The weather has been clear since release.
10 September	Over 3 nights (7–9 September) 79 mealworms have been eaten, and lots of new bat droppings are noted in the hackbox. The dish is refilled with 200 fresh mealworms.	15 of the 79 mealworms eaten were chomped in half in the dining style of the mother bat. 7 September was clear, but 8–9 September were rainy.
23 September	No mealworms have been eaten over 13 nights, (10–22 September), although the dish is refilled with 200 fresh mealworms every 2 or 3 days.	5 or 6 individual bats continue to forage at the farmhouse and roost under the porch roof.
27 September	Over 4 nights (23–26 September), 24 mealworms have been eaten, and the dish is refilled with 200 fresh mealworms.	No new bat droppings are noted in the hackbox, but two small bird droppings are dried on the outside top.
23 October	No mealworms have been eaten over 26 nights, although the dish is refilled every 2–4 days. The hackbox is taken down on 23 October 1999.	The five or six bats continue to forage at the farmhouse and roost under the porch roof until they leave for hibernation in mid-October.

dusk the author stood on a stepladder, and peered into the crevice under the porch roof where five or six bats were still roosting. All but one moved away immediately. The calm one remained where it was, about 15.24 cm (6 in) from the author's nose. Was it Peep? The author believes it was, but no positive identification was made.

The hackbox dish was restocked with fresh mealworms every day or two. September 8 and 9 were rainy, but when the dish was checked on 10 September, 79 mealworms had been eaten over 3 nights (7–9 September); 15 were chomped in half in the mother bat's style. There were lots of new bat droppings, and the author speculated that both Peep and the mother bat may have used the back-up food source (on the two rainy nights?) since a higher percentage of half-eaten mealworms would be expected if the mother bat ate all 79. The last time mealworms were noted missing was 27 September, when 24 had been eaten, two half-eaten, and two all but the heads. However, there were no new bat droppings that time, and two

small bird droppings adorned the top outside of the box. Nevertheless, the 5 or 6 bats were still roosting under the porch roof, so the food dish was kept restocked. Below freezing temperatures first occurred 5 October, with milder Indian Summer weather in mid-October. By 23 October the bats were all gone, and the hackbox was retrieved (Table 2).

Discussion

Postrelease observations did not provide conclusive evidence that Peep's release was successful, but the author is optimistic. Peep gave every indication she was ready and able to rejoin the wild colony. The twin youngsters, on the other hand, had given cause for concern when they did not access food in the hackbox in the flight tent, and the release attempt was, in hindsight, ill-advised. Luck was on their side when they were retrieved in time. A bat pup showing shortened body and forearm length for its species may not be a candidate for release. These twin youngsters appeared healthy and active but were significantly undersized for their species. They were born to a mother that had been admitted into care, and subsequently gave birth while in captivity. Since big brown bat pups attain 75% of adult body weight and more than 95% of forearm growth solely on mother's milk before first flight (Burnett and Kunz 1982; Kunz and Anthony 1982), whatever incapacitated the mother may have led to a less than optimal prenatal and/or early postnatal development for the pups.

Update on the Twins

The twin youngsters had been marked with two fluorescent dots on 25 August. Both removed one of them, the lower back marker, without incident a few days after their return to care. However, the female had an episode of illness a week later. She contracted a case of mites and scratched her shoulder marker off, creating a superficial wound. It was cleansed with warm water and polysporin was applied when she was fed that evening, and she seemed fine. However, the next night she was found on the bottom of the cloth-lined roost, with shallow rapid breathing. She was kept very warm and offered oral hydration several times overnight and seemed to recover fully in 24 hours. The male's shoulder marker, on the other hand, fell off without incident about 2 weeks after it had been glued on.

CrazyGlue was likely not the best adhesive to use. Fry (1995) noted a similar problem in his study. The ANDREA eyelash glue he used to attach a "dummy" telemetry transmitter weight on a big brown bat youngster resulted in skin irritation serious enough to delay release. Edwards (1999, pers. comm.) recommends Skin Bond® to glue telemetry receivers to bats. Only a very small speck of the CrazyGlue was used for the fabric dots, and the author tried not to get it on the bats' skin (i.e., just the fur), but obviously the female youngster's shoulder marker was glued to her skin and, along with the mite infestation, resulted in skin irritation. Her extreme reaction was unexpected, but in future the author would be even more careful about using the tiniest bit of glue if marking a bat in this way, and she would use Skin Bond®.

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Note: *Appendix 1, Published North American Release Studies, and Appendix 2, Unpublished North American Bat Release Strategies, begin on page 12.*

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TABLE 3. PRODUCT SOURCES AND INTERNET SITES

Fluorescent Fabric	Lightweight fluorescent fabric: Flash Back, available from: Bike-Up Canada, 6 Antares Drive, Phase II, Unit 10B, Nepean, Ottawa, Ontario, K2E 8A9; Tel: 613/226-6452 or 1/800/661-3506; Website: www.bikeup.com.
Glue	CrazyGlue (caused skin irritation, so is not recommended), Elmer's Products Canada Inc., Burlington Ontario. Skin Bond® is recommended, available from Canadian Howmedica, Guelph, Ontario.
Hackbox	116-liter plastic storage bin used as hackbox. Available at hardware stores or from: Storage Solutions, Gracious Living, Woodbridge, Ontario; Tel: 1/800/465-5660.
Mealworm Suppliers	Listing is available online at the IWRC website: www.iwrc-online.org/rehab/mealworms.htm or at: www.deadanimal.com/crix.html. Supplier used in this study was Grubco, Hamilton, Ohio; Tel: 1/800/222-3563.
Telemetry Equipment	Small 0.47 g. radio transmitters are available from: Holohil Systems Ltd, 112 John Cavanagh Road, Nepean, Ontario; Tel: 613/839-0676; Website: www.holohil.com.
Waxy Cattle Markers	Nontoxic, colored markers that look like large crayons. Available at Farm Co-op stores.
BATLINE	An Internet mailing list for bat workers. To subscribe, send an e-mail to: majordomo@lads.com with a blank subject line and text that reads: subscribe BATLINE YourE-mailAddress.
WLREHAB	An Internet mailing list for wildlife rehabilitators. To subscribe, send an e-mail to: listserve@listserv.nodak.edu with a blank subject line and text that reads: subscribe WLREHAB.
WORLDBATLINE	An Internet mailing list for bat workers. To subscribe, send an e-mail to: worldbatline-subscribe@yahoogroups.com with a blank subject line and text that reads: subscribe WORLDBATLINE YourE-mailAddress.

APPENDIX 1. PUBLISHED NORTH AMERICAN BAT RELEASE STUDIES

AUTHOR/DATE/ SPECIES/AREA	TIME IN CARE	RELEASE STRATEGY	POSTRELEASE
Authors: B. Adkins and J. Wasserman **Publication Date:** 1993 **Species:** Big brown bat (*Eptesicus fuscus*) **Study Area:** HOWL Wildlife Center, Washington	**Intake:** spring 1993, one newborn infant, 4 g, eyes closed	The pup learned to fly in a ~3.1 x 3.7 m (~10 x 12 ft) outdoor cage and a big 3.1 x 21 m (~10 x 69 ft) indoor room. It was taught to recognize natural food items and eat mealworms in flight by being tossed gently into the air after grasping a mealworm from forceps. Fitted with a 0.65 g Holohil transmitter, it was released directly in front of a roost entrance at a maternity colony in a four-story building. The youngster crawled inside the roost and remained there the first night. It exited with the colony the next night, but was grounded, recaptured, and kept 1 night.	After a 2nd release off the roof of the building the next evening, the youngster was tracked and observed feeding at the edge of the lake. It roosted in a large maple tree that night, and the following 2 nights. The telemetry equipment malfunctioned briefly, but the bat was again tracked to a tree on the edge of the lake on the 4th night after its release from the building roof. The transmitter was found shed under the tree, but a bat was observed leaving this tree and feeding over the lake. Adkins and Wasserman were confident it was the study bat.
Author: C. Dicke **Publication Date:** 1994 **Species:** Pallid bat (*Antrozous pallidus*) **Study Area:** Northern coastal California	**Intake:** 29 July 1993, one male pup, younger than 6 weeks, nonvolant **Release:** 12 September 1993	After the youngster was flying and self-feeding on mealworms, it was banded with a British Mammal Society band; a 0.65 g Holohil radio transmitter was glued on using Skin Bond®. The bat was then released in an attic near where it had been found. Mealworms and water were left within reach. Release weight was 23 g.	The bat stayed in the attic until the 5th night. On the 7th night, it was spotted hanging with the main pallid bat colony in the nearby barn. On the 8th night, it was recaptured and the radio transmitter was removed. The bat appeared healthy and feisty; it weighed 19 g, down 4 g from release, but still within normal weight range. One month postrelease, the bat was again sighted hanging with the main colony in the barn.
Author: M. Fry **Publication Date:** 1994 **Species:** Big brown bat (*Eptesicus fuscus*), silver-haired bat (*Lasionycteris noctivagans*), and red bat (*Lasiurus borealis*) **Study Area:** Minnesota	**Intake:** Summer 1993, two big brown bats, one silver-haired bat, and one red bat; all young infants **Release:** Late summer 1993	At about 5 weeks of age the four bats were placed in a large 2.4 x 2.4 x 4.9 m (8 x 8 x 16 ft) outdoor flight cage stocked with food and water. Flying insects were attracted into the cage with a lantern. The bats maintained their weight for several days once supplemental feeding was stopped. A few weeks prior to release the bats were banded, and a 0.6 g weight equivalent to a radio transmitter was glued onto the two big brown bats using ANDREA eyelash glue. The weights fell off in 2.5 weeks, but injury to the bats' skin under the glue delayed release, and Fry decided against the use of real radio transmitters.	Postrelease observations were not reported.

APPENDIX 1. PUBLISHED NORTH AMERICAN BAT RELEASE STUDIES, CONTINUED

AUTHOR/DATE/ SPECIES/AREA	TIME IN CARE	RELEASE STRATEGY	POSTRELEASE
Author: L. Finn **Publication Date:** 1996 **Species:** Evening bat (*Nicticeius humeralis*) **Study Area:** Florida	**Intake:**early June 1996, one pup about 1 week old one pup about 3 weeks old **Release:** 25 June 1996, one pup about 4 weeks old one pup about 6 weeks old	After these bats were flying and self-feeding on mealworms, they were banded with plastic split ring bands and released into an inhabited bat-house (BCI design) that housed a resident maternity colony of about 15 evening bats. Mealworms and water were left within reach.	The bats did not leave the bat-house the first night, but were seen foraging with the colony for a few nights before the whole colony relocated to a nearby bat-house (less accessible for monitoring). Later some returned to the original bat-house. 15 days postrelease, one banded bat was sighted still with the colony.
Author: B. Malinics **Publication Date:** 1996 **Species:** Big brown bat (*Eptesicus fuscus*) **Study Area:** Pennsylvania	**EFFORT 1:** **Intake:** Spring 1996, two big brown bat pups born in captivity **Release:** ~4 weeks of age, along with their mother **EFFORT 2:** **Intake:** Summer 1996, four young big brown bat pups (two males, two females) **Release:** once self-feeding and flighted	In both of these releases, Malinics used a similar "hackbox" strategy. The bats were placed in an open cage near an open window in the loft of a barn at the release site, and a feeding station was stocked with mealworms and water.	**EFFORT 1:** The mother bat and youngsters left the cage the night of release, but were all back in the cage 3 days postrelease. The evening of the 4th day, one youngster was found inside the cage, and was placed on top of the cage. Subsequently, bats were seen flying outside the barn, but never back inside again. **EFFORT 2:** The two male bats were sighted occasionally after release, using the feeding station.
Author: C. Scott **Publication Date:** 1996 (*Also published by C. Scott and C. Dicke in 1998*) **Species:** Pallid bat (*Antrozous pallidus*) **Study Area:** Northern coastal California	**Intake:** Summer 1995, two female pallid bats, young infants **Release:** 3 October 1996, about 16 months old	On 18 August 1996 the two yearling bats (and eight other bats) were placed in a 2.4 x 2.4 x 12.2 m (8 x 8 x 40 ft) outdoor flight cage. Water and a bowl of mealworms were provided. By 12 September they were self-feeding. On 3 October, one bat was banded with a Lambourgne band, and a 0.78 g Holohil radio transmitter was glued on with Skin Bond®. Both bats were then released into the existing pallid bat colony at the release site.	Release weight of the radiotracked bat was 22.5 g. The bat was recaptured 17 days postrelease, and the transmitter was removed. The bat now weighed 23 g. One month postrelease, the bat was seen hanging with the main colony in the barn at the release site. At 6.5 months postrelease, it was again sighted with the colony.
Author: P. Winters **Publication Date:** 1997 **Species:** Yumi bat (*Myotis yumanensis*) **Study Area:** California	**Intake:** Late May 1997, 18 young infants, from newborn to 2 weeks old **Release:** 25 July, released 12 bats at ~2 months of age 3 September, released three bats at ~3 months of age	After weaning, the bats were raised in 0.9 x 0.9 m (3 x 3 ft) cages and allowed extra flight in a large room. When they were flying well and self-feeding, they were banded using Lambourne bands. They were then released back to their natal colony in the rafters of a horse barn. A small shelf was constructed high in the barn about 1.5 m (5 ft) from the roost, and mealworms and water were left there within reach.	The youngsters quickly dispersed into the natal colony. They were sighted postrelease, up to six simultaneously. On 18 August, two bats were recaptured. The male had lost just 0.1 g; the female had maintained her release weight. **Update:** Two banded females were recaptured in 1999. Both were doing well and raising infants (Winters 2000, pers. comm.).

APPENDIX 1. PUBLISHED NORTH AMERICAN BAT RELEASE STUDIES, CONTINUED

AUTHOR/DATE/ SPECIES/AREA	TIME IN CARE	RELEASE STRATEGY	POSTRELEASE
Author: P. Winters **Publication Date:** 1998 **Species:** Big brown bat *(Eptesicus fuscus)* **Study Area:** California	**Intake:** Spring 1997, two young infants and one nonvolant youngster, transferred to Winters at 1 year of age in spring 1998 **Release:** Early summer 1998, at a little older than 1 year of age * For their first year, these bats had been kept in a cage too small for proper flight	After the bats were transferred to Winters they were introduced into a large ~3.1 x 1.2 x 2.7 m (~10 x 4 x 9 ft) indoor flight cage. When they were flying well and self-feeding on mealworms, they were banded. They were then released to a crevice in fascia boards on a house with resident big brown bats roosting in many such crevices. Mealworms and water were left within reach.	The feeding station was not used for 1 week, but then many mealworms were eaten, indicating more than one bat was using it. One banded bat was sighted roosting with the colony bats for more than a month postrelease. **Update:** The food dish was used for 5 weeks until it was finally removed. One banded individual was spotted ~9 weeks postrelease flying (apparently hunting with other bats) in the wooded backyard, where the colony resides in the eaves of a house (Winters 2000, pers. comm.).
Author: B. Schmidt-French **Publication Date:** 2002 **Species:** Red bat *(Lasiurus borealis)*, Yellow bat *(Lasiurus intermedius)* **Study Area:** Texas	**Intake:** 31 May–15 August 1999–2001 **Release:** through mid-August 1999–2001	Orphans are hand-raised on replacement milk and blended mealworm formulas and switched to whole mealworms as soon as they will accept them. Once bats are flying inside indoor flight cages and feeding aggressively on whole mealworms, they are moved to an outdoor flight cage 18.3 x 6.4 x 3.5 m (60 x 21 x 11.5 ft). The cage is constructed from a metal greenhouse frame and covered with heavy-weight polypropylene netting with a 6.4 mm (0.25 in) mesh. Approx. 1–2 dozen orphans are put in the cage each season. They are placed within foliage covering the ceiling of the cage; small water dishes are attached to the foliage. Incandescent and black lighting attracts insects. Orphans are hand-fed 3–4x per day until they begin feeding on flying insects. Droppings are examined daily to determine when individual bats are feeding on flying insects. Hand-feedings are reduced to 2x and then 1x per day as the bats become more proficient feeders. Bats are released into the surrounding woodlands that serve as their species' natural habitat once they (1) maintain their weight on flying insects without supplemental feedings for 1 week, (2) exhibit significant night-time flying activity, and (3) return to appropriate roosting spots within foliage on their own for daytime roosting.	Due to the likelihood of attracting fire ants, trays of mealworms that were provided outside of the cage (hung from the netting) were made available only for a short period each night for the first few nights following release, although bats were never observed feeding from them. Because red bats appear to be particularly susceptible to injury, no attempt at marking individual bats was made, although red bats are subsequently observed each season roosting in the surrounding hackberry and Chinaberry trees through the end of August, and two young males of appropriate weight were retrieved from leaf litter during a cold spell on 9 October 2000.

APPENDIX 2. UNPUBLISHED NORTH AMERICAN BAT RELEASE STRATEGIES

AUTHOR/DATE/ SPECIES/AREA	TIME IN CARE	RELEASE STRATEGY	POSTRELEASE
Rehabilitators: E. Butler and S. Walker mcbutler@chat.carleton.ca sdw60@sympatico.ca **Study Date:** 1999 **Species:** Big brown bat (*Eptesicus fuscus*) **Study Area:** Ottawa, Canada * The study in this paper	**EFFORT 1:** **Intake:** 5 June 1999, twin newborn pups and their downed mother. The mother and male pup died hours after intake. The female pup, survived. **Early Care:** In Butler's care the female pup was housed in an incubator and fed milk formula from a foam-tip eye shadow applicator. **Release:** 25 August 1999 at 11.5 weeks of age. **EFFORT 2:** **Intake:** Twin pups born in April, a month ahead of the wild schedule, to a captive mother that had come into Walker's care in February 1999. **Early Care:** The twins were reared by their mother and learned to fly in an indoor room. The three were transferred to Butler's flight tent on 12 July 1999 when the twins were 10 weeks old. **Release:** (failed) 25 August 1999, at 16.5 weeks of age.	**EFFORT 1:** The orphaned pup learned to fly in an indoor 3.7 x 1.4 x 2.4 m (12 x 4.5 x 8 ft) tent sewn from sheets (obviously flimsy, used only in a secure room), and hung over an open screened window. It learned to self-feed and fly to a 116-liter plastic storage-bin hackbox furnished with cloth roosts, a dish of mealworms, and a hamster water bottle. It was housed in the tent with a mother big brown bat and her two offspring that had been born in captivity 5 weeks ahead of the wild schedule (see below). **EFFORT 2:** Once in Butler's flight tent, the twin youngsters quickly learned to self-feed from bowls placed low in the tent. However, they did not fly to the mealworm dish to eat when it was placed in a hackbox set on a 0.9 m (3 ft) platform. Nevertheless, on 18 August 1999 they were confined to the hackbox along with the orphaned female pup from Effort 1 and their mother. The hackbox was then transferred to the release site and hung at the entry to the natal maternity colony roost of the single female orphan.	The four bats were kept confined in the hackbox for 1 week at the release site. On 25 August 1999 they were marked with two paper-punch-sized pieces of lightweight fluorescent fabric glued to the fur on their backs, and the hackbox was opened. The mother bat and the single female orphan were gone by the next morning, but the twin youngsters did not leave the first night, and when the male did venture out of the box after dark the following night, he fluttered to the ground. These two were returned to Walker's rehab care. Mealworms and water were replenished in the open hackbox and were noted to have been eaten overnight 30 August (13 eaten over 3 nights), again 10 September (79 eaten over 4 nights), and again 28 September (24 eaten over 4 nights). In the first two instances, lots of new bat droppings were noted in the hackbox, and on 30 August Butler noted a "calm" bat roosting in a crevice under the porch roof with five or six other bats. No positive ID was made, but she speculates that it was the single orphan female.
Rehabilitator: L. Finn Laura@flybynightinc.com **Study Date:** 1999–2000 Unpublished rehab. notes **Species:** Evening bat (*Nicticeius Humeralis*) **Study Area:** Florida	**Intake:** Four pups born to female bats in rehab care, spring 1999 **Release:** Summer 1999 at about 5 weeks of age	After these bats were flying and self-feeding on mealworms, they were banded with plastic split-ring bands and released into an inhabited bat-house (BCI design) that housed a colony of about 75 evening bats.	The bat-house was monitored closely in case one of the young bats became ill or too thin. The banded bats were confirmed in the house until the colony left in September. In January 2000 one of the banded bats was seen in the bat-house hanging with a few others from the colony.

APPENDIX 2. UNPUBLISHED NORTH AMERICAN BAT RELEASE STRATEGIES, CONTINUED

AUTHOR/DATE/ SPECIES/AREA	TIME IN CARE	RELEASE STRATEGY	POSTRELEASE
Rehabilitator: A. Lollar sanctuary@batworld.org **Study Date:** 1999–2000 Unpublished rehab. notes **Species:** Mexican free-tailed bat (*Tadarida brasiliensis*) **Study Area:** Mineral Wells, Texas	**Intake:** Orphans are rescued from Bat World's Wild Sanctuary building, which houses a colony of approx. 20,000 bats. Over a 4-week period each summer, 2–3 dozen emaciated and abandoned pups are found ranging from a few hours to a few weeks of age at intake. **Release:** Youngsters average 8 weeks of age at the time of release, about 2 weeks after they are flying and weaned onto mealworms, blended or whole.	The bats are marked by a tattoo on the ear and are placed in a large 3.1 x 9.1 x 2.1 m (10 x 30 x 7 ft) prerelease cage in the colony roost in the Wild Sanctuary building. They remain there for 2 weeks and are hand-fed if necessary or have mealworms and water provided in shallow bowls for those that self-feed. The cage is then opened and the youngsters are allowed at their own accord to rejoin the wild colony.	Youngsters have usually left the cage within 10 days. Back-up food and water is provided in the open cage for 6–8 weeks, and the cage is checked 2x a day at the usual feeding times. One tattooed individual was spotted a week after leaving the prerelease cage. It appeared healthy and well groomed. When approached it shied away with the rest of the group, out of reach, so further inspection was not possible.
Rehabilitator: L. Sakolsky fmrc@bellatlantic.net **Study Date:** 1999–2000 Unpublished rehab. notes **Species:** Big brown bat (*Eptesicus fuscus*) **Study Area:** Pittsburgh, Pennsylvania	**Intake:** six to eight young orphans nearly every June (~ last 2 weeks in June) **Early Care:** Most orphans are housed in Feather Farms brooders (incubators) and are fed formula from a catac nipple or small plastic tubing pushed onto a 1 cc syringe. After they are eating well they are fed from shallow jar lids. **Release:** About mid-August for most orphans, when they are about 2 months old. Some are overwintered and released at 1 year of age.	After the bats are flying, the youngsters are free in a room with other big brown bats (including four adult permanents). When they are weaned and self-feeding from dishes in the room, they are put outside in a 2.4 x 2.4 x 3.1 m (8 x 8 x 10 ft) prerelease cage made of 6.4 mm (0.25 in) plasticized wire mesh. The cage has a nestbox and is stocked with dishes of mealworms and water. Insects are attracted to the cage and property by a light. There is a wetland nearby and resident colony of big brown bats. After about 2 weeks the prerelease cage is opened and either the youngsters are simply free to go, or they are placed in local barns into resident bat colonies.	After release the cage is left open and stocked with back-up food and water for about a week. Sometimes the mealworms are eaten. One released bat returned injured to the cage 2–3 days postrelease, and another was noticed back in the cage after release, but when startled it immediately flew away.

APPENDIX 2. UNPUBLISHED NORTH AMERICAN BAT RELEASE STRATEGIES, CONTINUED

AUTHOR/DATE/ SPECIES/AREA	TIME IN CARE	RELEASE STRATEGY	POSTRELEASE
Rehabilitator: P. Winters batmam@aol.com **Study Date:** 1998–2000 Unpublished rehab. notes **Species:** Big brown bat (*Eptesicus fuscus*), yumi bat (*Myotis yumanensis*), pallid bat (*Antrozous pallidus*), Mexican free-tailed bat (*Tadarida brasiliensis*), and California myotis (*Myotis californicus*) **Study Area:** Northern coastal California	Hand-reared orphaned pups or pups born to captive mothers are housed in flight cages until they are flying well, and until nights are sufficiently warm and the wild insect population is plentiful and adequate to support them.	Youngsters born to mothers that are releasable are released with their mother back where she was found. Youngsters born in captivity to unreleasable mothers, and orphaned captive-reared youngsters are released into a known conspecific colony in relatively protected areas. Some (big brown bats, pallid bats, and yumi bats) individuals are banded with Lambourgne bands prior to release. California myotis are not banded due to their small size; and Mexican free-tail bats are not banded because bands on this species often result in inflammation/ skin irritation that has occasionally proven fatal. One release strategy involves providing a feeding station at the release site. Dishes that the bats are familiar with in the flight cages are placed at the release site, close to the roost, and fresh meal-worms and water are provided daily postrelease.	Banded big brown bat and yumi bat juveniles have been observed using the feeding stations. They were noted to stop by as soon as they emerged for the evening to eat from the dishes before flying off to forage for themselves. Banded pallid bat individuals (and wild bats of all species) were never observed using the feeding dishes. They seemed to ignore them.

CORRECTION: Table 3 in Part II of this article (*Journal of Wildlife Rehabilitation* 24.3: 8) contained some incorrect information. The corrected table is given below:

TABLE 3. WEIGHT, LENGTH, AND FOREARM MEASUREMENTS

Bat	Age	Weight	Body Length	Forearm
Peep	5 weeks	17.4 g	~ 7.6 mm (~ 3 in)	45 mm (1.8 in)
male twin	10 weeks	15.8 g	(*no more than 57 mm [2.25 in]	38 mm [1.5 in])
female twin	10 weeks	17.7 g	(*no more than 57 mm [2.25 in]	38 mm [1.5 in])

**57 mm (2.25 in) body length and 38 mm (1.5 in) forearm measurements for the two youngsters are from a later date in early August.*

Rehabilitation Notes: Rock Hyraxes (*Procavia capensis*)

by Mara S. Kraemer

ABSTRACT: Four orphaned rock hyraxes (*Procavia capensis*) were successfully raised and released in southeastern Nigeria. This article details the methods and materials utilized in the hyraxes' captive care and describes their release into a natural habitat. It also includes an overview of the natural history of the species.

KEY WORDS: rock hyrax, *Procavia capensis*, orphaned wildlife, Nigeria, West Africa

MARA S. KRAEMER raised and released orphaned wild animals in Nigeria from 1988–97. She has done animal care volunteer work at the Chico Creek Nature Center, a wildlife museum and natural history education center in Chico, California. She is currently in her senior year working toward a bachelor's degree in natural history with a minor in biological sciences at California State University, Chico.

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Introduction

The rock hyrax (*Procavia capensis*) is a particularly intriguing species. While they are similar in appearance to a large rodent, rock hyraxes are in fact most closely related to elephants. They are highly social, and a physiological limitation (poor thermoregulatory ability) is related to this sociability, to their habitat requirements, and to their unique intergenus relationship with bush hyraxes. Rock hyraxes inhabit isolated rock outcrops in Africa and the Middle East and are well adapted to this niche. *Procavia capensis* is a hardy species and fares well in captivity. With suitable housing providing natural feeding and sheltering opportunities and a gradual introduction to a wild colony, release is likely to be successful.

Statement of the Problem

When living in Nigeria, West Africa, the author acquired four rock hyraxes from an opportunistic hunter who wanted to sell them. Their size suggested they were only a few days old. The two females were just 15 cm (6 in) long and the two males were between 16.5 and 18 cm (6.5–7 in) long.

Methods

Captive Care

For the first day of care, the young hyraxes were offered full-cream powdered cow's milk mixed at 75% strength from a kitten feeding bottle every 4 hours. Each hyrax drank approximately 25 ml at each feeding. The youngsters were also offered and ate small amounts of cabbage leaves and the leaves and stems of coat buttons (*Tridax procumbaens*) and a milkweed (*Euphorbia heterophylla*, two plants that occurred in areas near the rocky outcrops of their natural habitat.

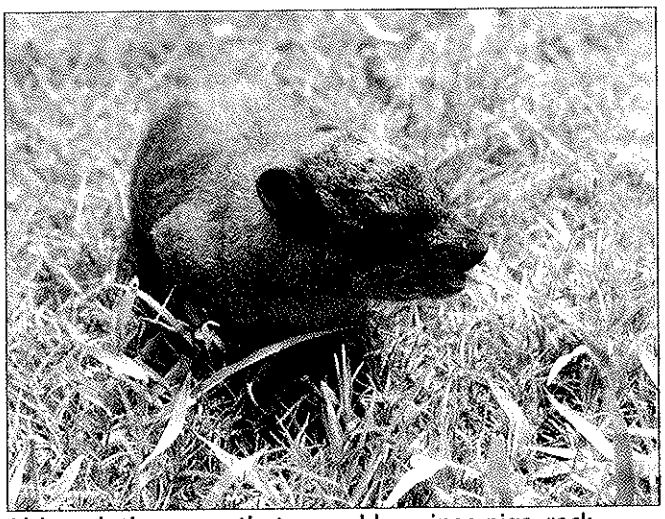
On the second day the hyraxes drank powdered milk that had been mixed at full strength, and by the third day they were drinking approximately 30 ml each 3 times daily. They also ate increasing quantities of greens—mixed chopped vegetables and fruits, and a variety of native plant stems and leaves.

While these hyraxes showed no lactose intolerance, it is not uncommon for hand-raised hyraxes to develop a lactose allergy. In these cases soya milk mixed at normal strength or evaporated milk diluted 1:1 with water may be used.

Water was kept available at all times, and during the first 2 weeks the hyraxes' water consumption increased, while their interest in the milk offered from the bottle decreased. From personal observation of wild hyraxes and consulting reference books, the author realized that rock hyraxes can go without moisture other than that obtained from their food. Moisture is conserved through urine concentration and fat utilization (Hallenworth 1980). The water dish was removed, and once the water was no longer available the hyraxes showed a renewed interest in the milk offered. By the end of the second week, they had learned to drink the milk from a bowl.

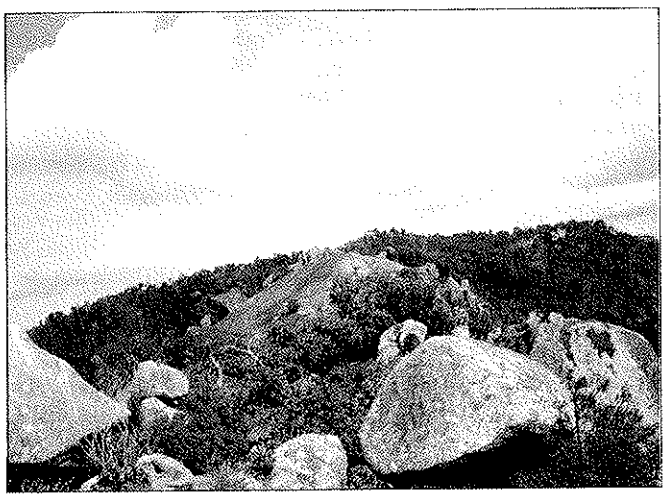
After 3.5 months the hyraxes were weaned from milk. Their agility at climbing and jumping allowed them to utilize their environment, which provided a very suitable temporary habitat. The author's house had a large covered porch and car park. This concrete area served as a sort of rock outcrop for the hyraxes. An additional feature of the house—a sloped, wedge-shaped wall jutting out at right angles to the side of the house—was especially suitable for them. Bougainvillea vines growing up and over each side of this wall provided shade and cover, and the slope was a perfect access ramp for the hyraxes to reach the roof of the house. The roof served as a lookout spot and a resting area, especially favored in the early morning and the evening.

While the house served as the hyraxes' rock outcrop, the yard was their grazing ground. They increasingly fed themselves by grazing in the yard. Although this feed-



PHOTOS: MARA S. KRAEMER

Although they somethat resemble guinea pigs, rock hyraxes are actually in the same suborder as elephants and sea cows. They weigh up to 5.4 kg, stand 25 cm high at the shoulder, and reach a body length of 54 cm.



Rock hyraxes live in colonies of up to 35 animals. They inhabit large areas of rocky habitat that provide protection from predators, the midday heat, and the night-time cold.

ing was sufficient for them, their diet was continually supplemented with fruits and vegetables. Ground cornmeal was an especially favored occasional treat, and was one of the few foods that could provoke a fight between the hyraxes. The fight would begin with a repetitive growl-snort that increased in volume and frequency until one hyrax would turn on the other with a show of teeth. With this threat, the hyrax being attacked would turn its rump in an apparent gesture of submission and as a shield. The short, dense hyrax fur was adequate protection against the drawing of blood, despite the ferocity of the fights.

Release

The mountains of the Cameroon/Nigeria border were close to the author's home, and she had frequently hiked in them and observed wild hyraxes. One isolated mountain informally known as Manya Mountain had extensive rock outcrops at its peak and on its slopes. Boulders that were tumbled and stacked on top of each other and were full of cracks and crevices presented a perfect habitat for hyraxes. This peak was selected as a suitable release location. In the rainy season when the hyraxes had matured, the author selected a foggy morning for the release, as the fog delayed the normal rapid rise in temperature. The cooler weather made the journey to the peak less stressful for the hyraxes, which were transported in carrying boxes by hikers. At the peak, a leaning slab of rock formed a sort of cave beneath it and there were plentiful signs of wild hyraxes in the area; the hikers had probably driven them into hiding among the boulders.

Once out of the carriers, the captive-raised hyraxes cautiously explored their new surroundings. The presence of the hikers kept the wild hyraxes hidden and gave the new arrivals time to gain confidence in their new territory. Within the first hour they, too, had disappeared into the rocks. An hour later they were sighted when they emerged yards away from where they had been last seen, apparently having used the passages of their wild cousins. Although the author and hikers remained in the area for a third hour, the hyraxes were not sighted again. The author felt confident that they would settle in to their natural home. They were familiar with the natural food plants in the area and capable of feeding themselves. They had shelter and knew how to hide from eagles and other predators.

An ideal release scenario would have been much more gradual. Hyraxes have a well-structured social hierarchy, and newcomers are not readily accepted into a group. Other rehabilitators have been successful using a cage at the release site and observing the behavior of the wild hyraxes with the hand-raised hyraxes in the cage to judge the receptiveness of the wild group. Once the hand-raised hyraxes are out among the wild group, such a cage can also provide a refuge/retreat for them if the wild hyraxes become aggressive.

While the release described here was not ideal, the author was confident that her hyraxes had a good chance of survival in their new habitat. Estes (1991) states that while female emigration is rare, female hyraxes "have been accepted (into a new) colony after the initial hostility of the resident females waned." Nowak (1999) and Parker (1990) also report that immigrant females are accepted. All male hyraxes disperse at adolescence and face the problem of finding an unoccupied portion of suitable habitat. Most settle on the periphery of a resident male's defended territory, awaiting the chance to take over that territory if something happens to the resident male. The release site the author used had extensive habitat over the entire mountain and she believed that the males would survive as periphery males to existing wild colonies until a chance to take over a territory presented itself.

Discussion: Natural History of the Rock Hyrax

Rock hyraxes are fascinatingly unique mammals. They are somewhat similar in appearance to a large rodent without a tail. The genus name *Procavia* means "pre-guinea pigs." Due to their appearance, hyraxes were originally classified as closely related to these rodents. However, modern classification places the Hydracoidea (the hyraxes) along with the Proboscidea (the elephants) and the Sirenia (the sea cows), into the suborder Paeungulata (Nowak 1999).

The hyrax phenotype is radically different to that of its close relatives. Rock hyraxes have a compact, chunky body without a tail. They can weigh up to 5.4 kg, stand 25 cm at the shoul-

der, and reach a body length of 54 cm. There is no sexual dimorphism (Parker 1990). The back is rounded due to a convex vertebral column from neck to rump (Walker 1975). The fur is thick and short, varying from soft to coarse, with an interspersal of long tactile hairs similar to whiskers. The fur is brownish-red to brownish-grey, merging to a lighter beige or golden color on the under-parts. The upper lip is cleft. The two upper incisors, which grow continuously and sometimes protrude below the upper lip, are long and razor sharp. These are used in defense. African hunters claim that a cornered rock hyrax can kill a dog (Kraemer, pers. observation). The lower incisors are used as a grooming comb. In the center of the back is a dorsal gland, a small bare patch surrounded by lighter colored fur. This fur is raised up at a 45° angle when the animal is startled. The raised fur is also used to indicate social status (Haltenorth 1980). The soles of the feet are flexible, with soft rubbery pads that are richly supplied with sweat glands. The continually moist soles, along with a "muscle arrangement that retracts the middle of the sole" (Walker 1975), allow hyraxes to use their feet as "suction cups" and give them extraordinary abilities in negotiating the steep rock faces of their habitat. There are four digits on the fore-foot and three on the hind-foot. Each digit has "crescent shaped bent 'nails' that are...quite like those of a human," but are in fact, "true hooves" (Parker 1990). The inner digit of each hind foot has a claw used in grooming.

Rock hyraxes live in colonies of as many as 35 animals (Estes 1991) on large areas of rocky habitat, such as granite inselbergs or kopjes, with sufficient shelter in cracks and crevices and beneath piled boulders. Here their "body whiskers" aid them in negotiating tight spaces. Hiding places amongst the rocks are necessary for escape from predators and for temperature regulation. Since rock hyraxes have "an unstable body temperature...a slow metabolism, and a high degree of heat loss" (Parker 1990), they use the rocky retreats to escape from midday heat and to huddle together for warmth at night.

The rock hyraxes in the genus *Procavia* are distributed from South Africa to Lebanon and Arabia (Parker 1990). This widespread genus includes an undecided number of species. Nowak (1999) states that "most authorities now recognize only a single species, *Procavia capensis*," but some authors list up to five species (Estes 1991; Feldhamer 1999), and Wilson (1993) names more than 50 synonyms for the species *Procavia capensis*. The range of *Procavia capensis* is limited by habitat requirements. However, according to Walker (1975), the "ecological limitations" restricting the order to "Africa and the Mediterranean regions" are "not well understood." Despite their poor thermoregulatory abilities, rock hyraxes occur at elevations of up to 5500 m in the alpine zone on Mount Kenya (Haltenorth 1980). So their range in Africa and the Middle East does not seem to be confined to these areas due to the climate. Obviously, they can survive in colder regions.

Procavia capensis feed on the grasses and other plants growing in the cracks in or at the edges of rocks. They also eat the leaves, fruit, and even bark of overhanging trees (Hallenorth 1980). Due to their ability to eat very rapidly, rock hyraxes spend a limited amount of time feeding. A "rock hyrax can take a bite as big as a sheep, enabling it to fill its...stomach within an hour or two" (Estes 1991). *Procavia capensis* can also eat a variety of plants, such as oleander (*Thevetia peruviana*), which are poisonous to other animals.

Female hyraxes come into heat once a year. The gestation period is extremely long for an animal this size: the average is 7.5 months. Litter size ranges from 1 to 4; the average is 2.4. All females within a colony give birth within a few weeks of each other (Parker 1990), and all the young "are cared for by the whole colony" (Dorst 1970). They are well developed at birth and can negotiate the rocks well in only a day or two (Haltenorth 1980). The young begin to eat solid food within 2–4 days and are usually weaned by 3 months (Estes 1991). Sexual maturity is reached at 16–18 months (Parker 1990).

There is an unusual relationship between *Procavia capensis* and bush hyraxes (*Heterohyrax brucei*). In areas where their ranges overlap, bush and rock hyraxes live together on the same kopjes (outcrops of granite rock). They huddle together in the same shelters, and their young play together (Parker 1990). They use the same latrines, forage together for a similar diet, and use very similar calls. Such a close association is not known among any other mammals except some primates (Estes 1991).

Conclusion

Procavia capensis is indeed a fascinating mammal species. Throughout most of its range this species is classified as "common in areas of suitable habitat" (Happold 1973). The nature of its rocky habitat makes it appear that rock hyraxes are in little danger as a species from humans. However, overhunting, mining of granite rock outcrops, and competition from domestic goats are serious threats that have driven local populations of rock hyraxes to extinction in some areas such as Egypt (Nowak 1999) and Nigeria's Jos Plateau (Kraemer 1988–97). Conservation efforts and in some cases rehabilitation can be valuable and necessary to ensure the survival of this species in the wild.

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Prey Remains in Bald Eagle (*Haliaeetus leucocephalus*) Pellets from a Winter Roost in the Upper St. Lawrence River, 1996 and 1997

by Anthony L. Lang, R. A. (Bud) Andress, and Pamela A. Martin

ABSTRACT: Regurgitated pellets of bald eagles (*Haliaeetus leucocephalus*) wintering along the upper St. Lawrence River, Canada, were collected from a roost site during 1996 and 1997. Analysis of the indigestible prey remains in the pellets provided some indication of diet. White-tailed deer (*Odocoileus virginianus*) were the most frequently encountered food species, occurring in 72 and 67% of the pellets in the 2 years, respectively. Other food items identified included waterfowl (40% in 1996 and 56% in 1997), fish (12% in 1996 and 28% in 1997) and furbearing mammals (9% in 1996 and 10% in 1997). Thirty (30) and 41% of the pellets contained remains of fish or fish-eating birds in the 2 years, respectively.

KEYWORDS: bald eagle, *Haliaeetus leucocephalus*, diet, pellets, St. Lawrence River, Great Lakes

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Introduction

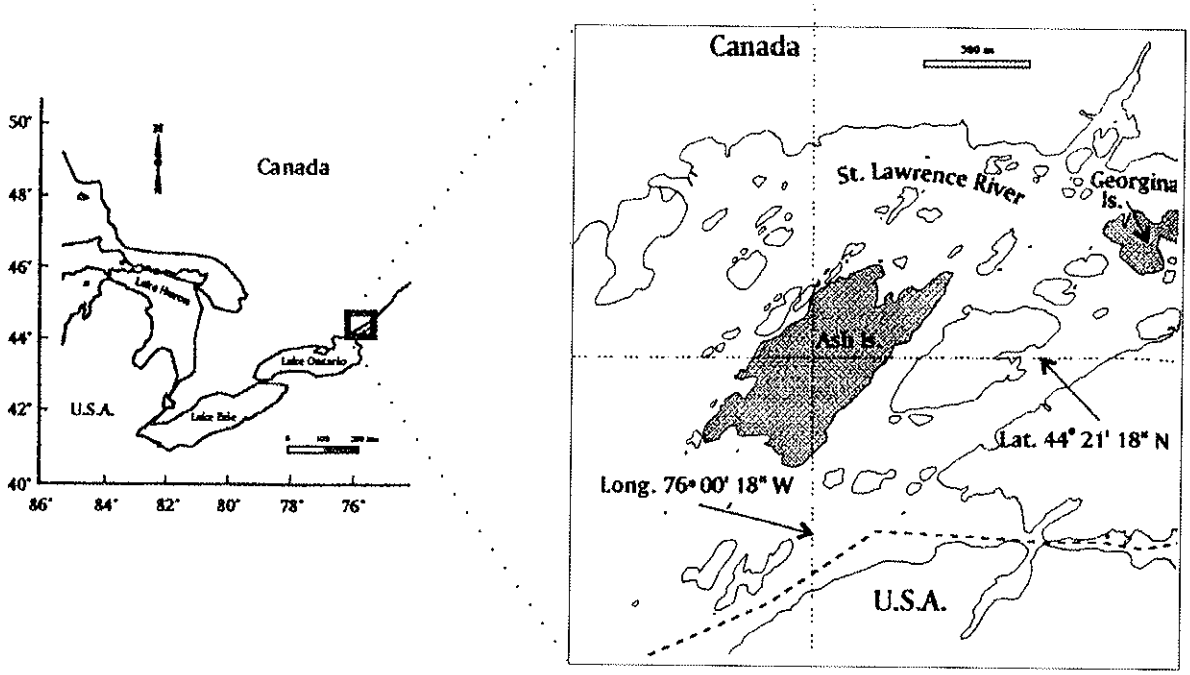
The bald eagle (*Haliaeetus leucocephalus*) was extirpated from the Great Lakes basin by the 1970s, due, in part, to severe reductions in reproductive success resulting from exposure to organochlorine contaminants (Postupalsky 1973; Weimeyer et al. 1984; Bowerman et al. 1994). Although breeding eagle populations in the Great Lakes basin began to rebound following the banning of most organochlorine pesticides in the 1970s, many areas of their former range, particularly along the shoreline of Lake Ontario, remain unoccupied. To determine sources of contaminants to eagles breeding in the Great Lakes watershed, much research has focused on the diets of nestlings (Kozie 1986; Bowerman 1991, 1993; Kozie and Anderson 1991). However, the contribution of the winter diet of adult birds to their contaminant burden has received less attention. Persistent organochlorine contaminants in food consumed during the winter and early spring may be incorporated into eggs, potentially affecting their hatchability and viability of the young. Although immature eagles may migrate down the Mississippi flyway during their first few winters of life, mature eagles (usually 4+ years) typically remain within the basin throughout the year (Bowerman 1993; Grubb et al. 1994). Therefore, the diet of birds wintering in the Great Lakes basin is of importance in determining the contaminant load carried by adult birds into the breeding season. The only comprehensive study of the winter diet of bald eagles in the Great Lakes and upper St. Lawrence River region was done by Ewins and Andress (1995) and was based on observations of foraging eagles.

All methods of estimating feeding habits are subject to biases. The use of visual observations of feeding raptors to determine diet may fail to document the use of all food types accurately. Larger, more visible prey items will be more easily seen and identified, whereas smaller items and prey consumed more quickly or in less visible locations, may be missed (Marti 1987; Mersmann et al. 1992). Pellet analysis is biased in that it relies on the presence of incompletely digested portions of prey items for detection. Thus, certain prey species may be underrepresented if they lack indigestible parts, and pellet analysis may be most effectively used to provide a qualitative picture of the diet, providing approximate indications of relative proportions within the diet (Mersmann et al. 1992). Because neither method adequately documents all food types, Mersmann et al. (1992) conclude that accurate assessment of bald eagle diet is best done using all available techniques. In an attempt to augment existing observational information on the winter diet of bald eagles in part of the lower Great Lakes basin (Ewins and Andress 1995), regurgitated pellets were collected and analyzed for two winters at a communal winter roost on islands in the upper St. Lawrence River.

Study Area and Methods

This study was part of a larger ongoing monitoring effort investigating the distribution and movements of wintering bald eagles in the St. Lawrence River region by New York State Department of Environmental Conservation (NYSDEC). This study involves the use of radio telemetry and aerial and ground surveys. In the St. Lawrence River at Gananoque, Ontario, Canada, the current is strong enough to keep the water open throughout the winter, providing access to fish, presumably enabling eagles to overwinter. Eagles normally occur there from early November to early April (B. Andress, pers. observation), but are not known to nest (Hunter and Baird 1995). A communal roost on Ash Island (latitude 44°21' 18"N, longitude 76°00' 18"W, Figure 1), situated 1 km west of the Canadian span of the Thousand

FIGURE 1. LOCATION OF ASH AND GEORGINA ISLANDS, THOUSAND ISLANDS IN THE UPPER ST. LAWRENCE RIVER.



Island bridge, was initially located from the Skydeck observation tower on Hill Island when 11 eagles were seen flying into a stand of trees on 4 March 1995. The roost consisted of a stand of mature white pines (*Pinus strobus*) stretching about 100 m along the southeast shoreline of Ash Island. On 16 March 1996 one eagle was observed flying into this roost at dusk and three NYSCED radioed birds were also located at the roost using telemetry. A mature eagle was observed at the Ash Island roost as late as the evening of 20 April 1996. In 1997, nine bald eagles were observed using the Ash Island roost, as well as the southwest shoreline of Georgina Island, on 22 March (D. Pilon, pers. comm.). On the same day, radio signals were received at dusk from eagles approximately 4 km southwest of the Ash Island roost site (B. Town, NYSDEC, pers. comm.). Ash and Georgina Islands are less than 1 km apart and considered to be part of the same roosting area. These roosts are approximately 1–2 km from permanently open areas of swift water on the St. Lawrence River. In addition to the aquatic food sources available from these areas of open water, white-tailed deer (for scientific names of dietary species see Table 1) are known to move across the ice between islands in this area, and carcasses are frequently available. Some carcasses had been set out during a joint trapping effort between NYSDEC and Parks Canada; numerous other deer were killed by coyotes (*Canis latrans*) or had fallen through thin ice.

Bald eagle pellets were collected 21 April 1996 (n = 43) on Ash Island, and 14 April 1997 on Ash (n = 139) and Georgina (n = 9) Islands. Discreet pellet samples were readily discernible, being tightly bound together with hair or feathers, and were bagged individually in the field and frozen until analysis. All samples from the 1996 collection were analyzed; a subsample of 39 pellets was selected for detailed analysis from the 1997 collection. Pellets were sorted visually based on their primary components (e.g., hair or feathers); proportional subsamples were selected randomly from within each group.

Pellets were air dried and dissected. Samples of hair, feathers, scales, and bones to be identified were set aside. Feather samples were washed and dried according to the procedure described by Sabo and Laybourne (1994). Scales and bones were also washed to facilitate identification.

Guard hairs from white-tailed deer were identified by visual comparison with hairs of known identity provided by Ontario Ministry of Natural Resources (OMNR, Peterborough, Ontario) and the Royal Ontario Museum (Toronto, Ontario). Other hairs were examined for identification using procedures described by Adorjan and Kolenoski (1969). The authors identified feathers by comparison with study skins at the Royal Ontario Museum. Bones were identified by staff at the Royal Ontario Museum. Loose fish scales were identified by comparison to samples of known identity provided by the Canadian Wildlife Service.

Results

In 1996, 33 (77%) of the 43 pellets contained predominately hair. The remaining 10 (22%) consisted primarily of feathers. Fourteen pellets (33%) contained both hair and feathers. Only 4 pellets (9%) contained no hair. Only 10 (23%) pellets contained a few small bones. In 1997, 25 (64%) of the subsample of pellets contained primarily hair, 14 (36%) consisted predominantly of feathers, reflecting the proportions

TABLE 1. NUMBER (%) OF BALD EAGLE PELLETS CONTAINING THE REMAINS OF DIFFERENT PREY SPECIES FROM WINTER ROOSTS ON ASH AND GEORGINA ISLANDS, UPPER ST. LAWRENCE RIVER

	NUMBER OF PELLETS (%)	
Species	1996	1997
Carp *(Cyprinus carpio)*	2 (4.7)	7 (17.9)
Bass *(Micropterus sp.)*	1 (2.3)	0
Rock Bass *(Ambloplites rupestris)*	0	1 (2.6)
Pike *(Esox sp.)*	0	2 (5.1)
Walleye *(Stizostedion sp.)*	0	1 (2.6)
Unidentified fish	2 (4.7)	2 (5.2)
Mallard *(Anas platyrhynchos)*	1 (2.3)	3 (7.7)
Wood Duck *(Aix sponsa)*	5 (11.6)	1 (2.6)
Greater Scaup *(Aythya marila)*	0	2 (5.2)
Common Goldeneye *(Bucephela clangula)*	1 (2.3)	3 (7.7)
Bufflehead *(Bucephela albeola)*	1 (2.3)	0
Common Merganser *(Mergus merganser)*	8 (18.6)	5 (12.8)
Unidentified duck	2 (4.7)	5 (12.8)
Unidentified bird	1 (2.3)	4 (10.2)
Muskrat *(Ondatra zibethicus)*	1 (2.3)	3 (7.7)
Squirrel *(Sciuridae)*	1 (2.3)	0
Mustelidae	1 (2.3)	0
Raccoon *(Procyon lotor)*	0	1 (2.6)
White-tailed Deer *(Odocoileus virginianus)*	31 (72.1)	26 (66.7)
Cow *(Bos domesticus)*	1 (2.3)	0
Unidentified mammal (hair)	19 (44.2)	10 (25.6)
Unidentified bone	2 (4.7)	5 (12.8)

NOTE: Table shows % totals > 100% as there were more than one food item per pellet.

of the entire sample of 148 pellets. Both hair and feathers were found in 12 (31%) pellets, and nine (23%) pellets contained remains of fish, mammals, and birds. Unlike 1996, 23% of the pellets did not contain hair of any kind, and 49% contained bone or bone fragments. The prey remains identified in the pellets are presented in Table 1. The most commonly identified food species in both years was white-tailed deer. Although a large proportion of pellets contained unidentified hair, most of these were underhair which, unlike guard hair, cannot be identified to species (D. Joachim, OMNR, pers. comm.). However, deer guard hairs were identified in all but four of these pellets in 1996 and one in 1997, suggesting that the underhair also came from deer. Ducks were the next most common food item identified in the pellets, with common merganser and wood duck remains most commonly observed. Few fish remains were found in the pellets; all of these were bones. Muskrat bones were identified in four pellets and the hairs of three other furbearing mammals were identified in other pellets. One pellet in 1997 contained a raccoon claw and underfur.

Discussion

Bald eagles are known to have diverse diets in the winter, opportunistically utilizing whatever abundant food resource is available. Eagles wintering inland in southern Ontario relied heavily on garbage at municipal dumps and deer carcasses (Ewins and Andress 1995); those wintering in inland Maine consumed starved or road-killed deer, cows, and moose (Todd et al. 1982). Waterfowl, often hunter-crippled, have been reported to provide an important food source for wintering bald eagles in areas where open water was available (Todd et al. 1982; Lingle and Krapu 1986; Griffin et al. 1982; Frenzel and Anthony 1989; Ewins and Andress 1995). The extensive use of hunter-crippled waterfowl by bald eagles wintering in the

TABLE 2. PROPORTIONS OF MAJOR FOOD TYPES IN WINTER DIET OF BALD EAGLES IN THE UPPER ST. LAWRENCE RIVER, DETERMINED BY ANALYSIS OF PELLETS COLLECTED IN 1996 & 1997 AND DIRECT FEEDING OBSERVATIONS 1987–95

	NO./PELLETS (%)		NO./OBSERVATIONS (%)
	This study		Ewins & Andress
Prey type	1996	1997	1995
Fish	5 (11.6)	11 (28.2)	59 (26.2)
Bird	17 (39.5)	22 (56.4)	14 (6.2)
Deer	31 (72.1)	26 (66.7)	139 (61.8)
Other Mammals	4 (9.3)	4 (10.2)	13 (5.8)

Fraser Valley, British Columbia, is evidenced by the repeated occurrence of lead poisoning incidences (Elliott et al. 1992). This study's examination of regurgitated pellets found at roost sites also indicated that bald eagles wintering along the upper St. Lawrence River had a diverse diet, with several species each of fish, waterfowl, and furbearing mammals being identified, as well as deer.

Selection of overwintering location may depend on many factors, including food availability. The frequent evidence of white-tailed deer in eagle pellets suggests that this species makes an important contribution to their winter diet. It is possible that eagles winter in this area because of the ease and likelihood of locating deer carcasses on the ice, rather than easy access to aquatic prey as a result of the open water. However, the true contribution of deer to the total energy intake of the eagles is difficult to ascertain given the biases of pellet analysis. Pellets of raptors, which are typically regurgitated daily (Duke et al. 1976), are composed of the indigestible portions of their prey, including bones, hair, scales, feathers, teeth, and chitin. Food that is highly digestible may not be represented in the pellets. The amount of indigestible material from a meal on a deer carcass would be greatly reduced once the hide had been torn through and exposed flesh was being eaten. Hair would largely be avoided at that point and eagles would pick flesh off the bones rather than consume them (Frenzel and Anthony 1989). Given this scenario, the contribution of deer to the diet may be underestimated through pellet analysis. Alternatively, with an intact deer carcass, much hair may initially be eaten with relatively little flesh being consumed, so that energy intake may actually be overestimated through pellet analysis (Mersmann et al. 1992). An accurate representation of the contribution of deer remains to the diet of bald eagles therefore, relies on the knowledge of whether the eagles fed on whole carcasses or on exposed flesh, which may only be determined through direct feeding observations.

Ewins and Andress (1995), through direct observations, also found deer to be an important component of the winter diet of eagles in the same area of the upper St. Lawrence River (Table 2), much less so for populations wintering in other portions of the Great Lakes basin. Those authors suggested there was a bias toward observations of eagles feeding on deer carcasses, given their large size and high visibility (usually on the ice) of the prey item, which could cause an overestimation of the contribution of deer where they occurred. However, both techniques of diet analysis, direct observation and analysis of pellets, yielded very similar estimates of eagle consumption of deer, calculated over seven seasons of observations and 2 years of pellet analysis, albeit in different years (Table 2).

Common mergansers occurred frequently in both 1996 and 1997, whereas wood ducks were only commonly identified in 1996; waterfowl jointly occurred in approximately half of all pellet samples (Table 2). Although wood ducks rarely overwinter in the upper St. Lawrence River, they may remain until late November and return in early March (B. Andress, pers. observation). As there is extensive duck hunting activity in the area, bald eagles may be consuming hunter-crippled birds unable to migrate. The contribution of waterfowl to eagle diets as assessed by direct visual observations was < 10% (Table 2). Ewins and Andress (1995) suggest this estimate may have been low, as waterfowl would have been captured at holes of open water, often away from convenient observation points; they are quite small and less obvious, and hence may have been missed. Despite the ability of raptors to digest bone and feathers (Glading et al. 1943; Duke et al. 1976), potentially biasing pellet analysis to underestimate the contribution of birds and small mammals, these dietary components appear to be well represented through this method of diet determination. Mersmann et al. (1992), however, found that medium-sized furbearing mammalian prey could actually be overrepresented in pellets because of difficulty in ridding the stomach and crop of short hairs, so that a single meal of an animal could contribute indigestible remains to more than one pellet.

Fish bones are apparently more completely digested by raptors than bones of other vertebrates (Todd et al. 1982), and it has been suggested that fish in the diet are severely underestimated by pellet analysis (Griffin et al. 1982; Todd et al. 1982; Kozie 1986; Bowerman 1993). Carp remains, in particular, occurred in pellets commonly in 1997, and accounted for the increase in the overall fish contribution that year. It is inter-

esting that indications of fish consumption by St. Lawrence River bald eagles as revealed by pellet analysis were similar to those found through direct observation of eagles, and both techniques, although not directly comparable, suggest that fish occurred in less than 30% of eagle meals (Table 2: Ewins and Andress 1995).

If the high frequency of deer remains in eagle regurgitant pellets truly indicates that deer constitute a large proportion of their winter diet relative to aquatic-based prey items, there may be implications for a reduced intake of persistent organochlorine contaminants. As terrestrial herbivores, deer are relatively low in organochlorine contamination, whereas fish and fish-eating birds in the upper St. Lawrence and eastern Lake Ontario are still quite highly contaminated (Pekarik et al. 1998). For example, in 1997 the eggs of herring gulls (which are primarily a fish-eating species) from Strachan Island in the St. Lawrence River contained 14 ppm PCB (wet weight), similar to levels in a known contamination hotspot, Hamilton Harbour in western Lake Ontario, where the mean PCB concentration was 12.7 ppm. These levels are far above those in bald eagle eggs known to cause decreases in productivity (Kubiak and Best 1991). It is largely unknown where eagles wintering in this region breed, but a radio-tagged male in 1994 and a radio-tagged female in 1997 were tracked to their breeding grounds in central Quebec (latitude 49°N, longitude 74°W: P. Nye, NYSDEC, pers. comm.). Whatever the case, apparent reliance on deer carcasses in their diet suggests that the birds wintering in the upper St. Lawrence River area are not returning to their breeding grounds with a substantial burden of organochlorine contaminants accumulated during the winter months.

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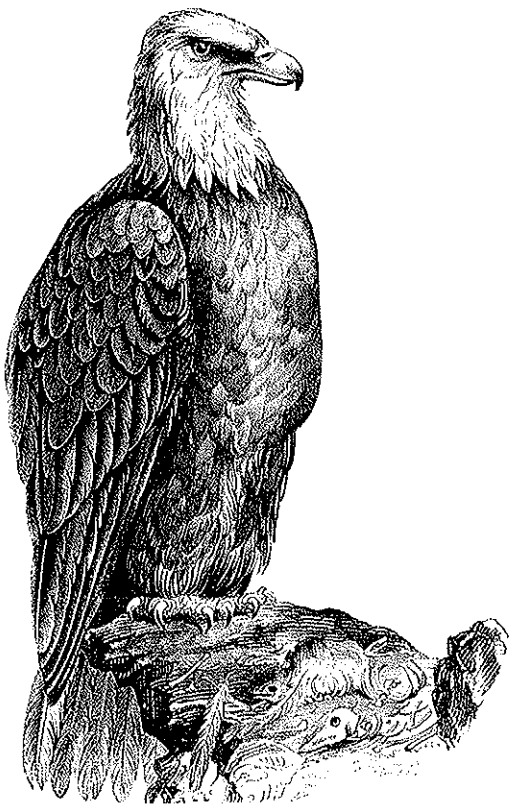
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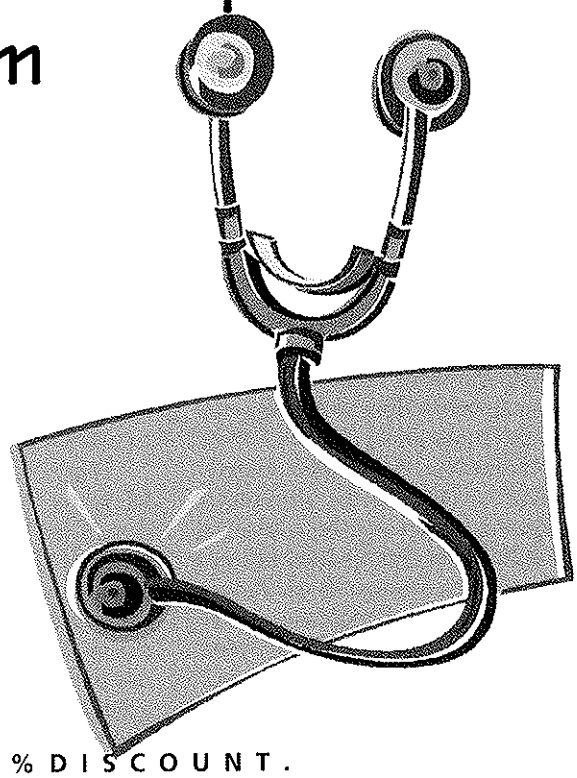
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COLUMN

Operating Instructions

RACCOONS AND SQUIRRELS...IN THE ATTIC

by Nathalie Karvonen

Many regions are still deep in winter's cold, and many wild animals have found relief from the cold in people's attics (although they may, of course, move in during any season). Weak spots in roofs—areas of decay, poorly secured vent covers, loose aluminum siding—all provide just the invitation an animal needs to access that big tree hollow people call "home." The good news: it's not usually too hard to get them to move on.

When a member of the public calls about a critter living in their attic, start with the basics. "What makes you think it is a raccoon?" "Are you sure the little guy is living in the attic? (Saying "little guy" doesn't sound quite as menacing as the caller surely thinks the animal is.)

To help the caller ascertain the species, have them use flour or baking powder to pick up paw prints or do a food test (e.g., raccoons like fish, squirrels do not).

Explain to the caller that the animal has moved into their attic because it is a warm, dark, quiet spot to live, not because it wants to torment them. People understand an animal's behavior better when they know what the animal would look for in the wild, and why their attic is an appealing alternative.

If the caller is not comfortable going onto the roof and into the attic themselves, give them the name and phone number of a good, *responsible* wildlife removal company, and explain why you are recommending them (as opposed to another company that may be cheaper). If the caller wants to solve the problem themselves—which we always encourage—they need to understand that *they* are responsible for their own safety.

Next, ask about access. Are the animals using only one hole? If the caller is not sure, they need to do a thorough check of their roof. If there is more than one access hole, they need to determine which is the primary hole. (They can do this by trying to pick up footprints at all the holes.) Once this hole has been determined, the caller should block up all the holes *except* the primary one. Holes should be blocked, at least temporarily, with galvanized hardware cloth or sheet metal. Later a roofing company can be contacted to repair it properly. *If there is more than one hole, make sure the caller knows whether they all lead to the same space on the inside. If not, an animal could be blocked inside.*

The caller needs to gain access to the attic, ideally through a trap door in the house, but alternatively by slightly widening the entrance hole, if possible. They should make lots of noise when approaching the entry and give ample time for any animals to get out the way. Do this at dusk or later for raccoons, dawn or during the day for squirrels. Once inside the attic, place a radio playing as loudly as they (and the neighbors) can stand. A bright light should be left in the attic as well; a strobe light is even more annoying. *Caution the caller to make sure they are not creating a fire hazard!*

These annoying elements should be left going 24 hours a day for at least two days, if the weather is mild. If the caller no longer hears noises, a scrunched-up piece of newspaper should be placed in the hole and left for another 48 hours, if the weather is mild. If the newspaper is not moved in that time, the caller can assume that the attic has been vacated and they may block up the remaining hole.

It is then critical that the caller reenter the attic, if at all possible, to check for damage (e.g., chewed wires), and have it repaired. They should also clean out nesting material, food, feces, and so forth. (Advise them to wear rubber gloves, a facemask, and protective clothing.) Entering the attic also provides a final opportunity to ensure that no animal has been trapped inside. *Again, advise the caller that if they are unsure they can do this safely, they should hire a company to do it.*

If the weather is very cold (like our hearty Canadian winters), enourage the caller to wait until it is just *a bit* warmer before starting the eviction. The trick is to wait until the coldest part of winter passes, but still send the critters packing before babies are born. If the caller absolutely will not wait, you will need to alter your advice a little. They will have to harass the animals on milder days, when they would normally be active. The caller should harass the animals longer than 48 hours and leave the scrunched-up newspaper in the hole for up to two weeks. Red squirrels usually store lots of food in an attic and may not come out for two weeks. In addition, going into the attic and checking to make sure there aren't animals left inside becomes vital. If it is red squirrels the caller is evicting, back-up feeding must be provided for the squirrels to replace the winter stores they had in the attic.

At times of the year when there may be young babies, strongly discourage evictions. The older the babies, the stronger the bond between the mother and her offspring: a new mom with neonate babies who is harassed is much more likely to leave her young than a mother with older babies. Ideally, the caller should wait until the babies are mobile before starting to harass the family.

Discuss preventive measures with the caller. Their roof should be regularly checked for areas of weakness that may allow animals access in the future. Trapping and relocating should *always* be discussed: if you don't educate the caller about this outdated practice, five minutes after your phone call, neighbor Bob will come over, give them a trap, and describe how easily it can solve their problem. Trapping and relocating wildlife leads to the death of many adult animals who are moved, spreads disease and parasites, leaves orphaned babies behind, and *doesn't* solve the problem.

Finally, if you can, send the caller written information to back up your discussion or call them a few days later to check on their progress. JWR

Nathalie Karvonen is the executive director of the Toronto Wildlife Centre. TWC operates a wildlife hotline service available to the public. Last year the hotline received more than 16,000 calls.

COLUMN

Open Minds

PAY NO ATTENTION TO THE EDUCATOR BEHIND THE CURTAIN...

by Kieran Lindsey

In the previous installment of Open Minds, I stated that the slide projector should be one of many tools in an educator's bag of tricks. Discovery Trunks, I went on to explain, are another of these tools. Of course, the astute reader will quickly determine that makes exactly two tools—not exactly a bag-full. So now we're going to talk about puppets.

> **Lambchop:** Puppets? Like me?
>
> **Kieran:** That's right, Lampchop. Puppets...just like you.
>
> **Lambchop:** But puppets are for little kids...and lambs!
>
> **Kieran:** Tell that to Kermit the Frog! Did you know *The Muppet Show* had a weekly audience of more than 200 million people in 100 different countries? And at least half of those watching were adults.
>
> **Lambchop:** Two hundred million! Bless my fleece, that's a big flock of people!

Puppets and puppet shows are found in cultures around the globe. Because puppets speak and have distinctive personalities, its easy for the audience to project themselves into this make-believe world. And puppets can get away with things their human counterparts would find hard to pull off. According to David Werner and Bill Bower, in *Helping Health Workers Learn: A Book of Methods, Aids, and Ideas for Instructors at the Village Level* (1982), "Puppets add a sense of pretending and humor that can make the feared parts of our daily life easier to look at." In other words, things that might cause an audience to feel uncomfortable when a real person says them are easier to accept from a puppet.

Including puppets in a Discovery Trunk allows the audience to explore ideas and concepts in their own unique way and at their own pace. But puppets have a place outside the trunk as well. And it's easy to create entertaining and informative puppet shows when you follow these six simple steps:

Helping Hands. Remember that it's much easier to develop the script based on the number of available puppeteers than to search for willing participants once the script is finished—especially if this will be a traveling show. Also keep in mind that playing more than one part at a time can be difficult for novice puppeteers.

Make It Snappy. Keep your puppets' dialog short and build in lots of action. Preachy puppets are every bit as boring as preachy people.

Face Facts. Faces improve the communication power of your puppet, and as in human communication, the eyes are especially important. Facial expressions should establish each puppet's personality; for example, use a frown for a crabby puppet or closed eyes for a bashful or timid character.

Mood Music. Prerecorded sound helps add richness and texture to your puppet show. Music sets the mood and helps puppeteers pace the dialog and action. Sound effects help transport the audience into your make-believe world.

Set the Stage. Not all presentations using puppets require a stage. For those that do, simple, colorful backgrounds help keep the audiences' attention and provide nonverbal clues to support the action. Scene changes can help to move the story along if they don't take too long to accomplish.

Short and Sweet. Ten or fifteen minutes is usually sufficient time to get your message across. If the message is too complex for that time frame, consider pairing your puppet show with another activity. It's better to leave your audience thirsty than to drown them.

Puppeteers are fond of saying, "Don't throw that away! It could be a puppet one day!" Some of the most effective puppets have been created from gloves, socks, kitchen sponges, clothespins, egg cartons...even cardboard toilet-paper rolls. For those who lack the desire to do-it-themselves, or when the presentation would benefit from realistic-looking characters, puppets can be purchased from both wholesale and retail sources. Hand puppets are readily available and easy to master. Hand-and-rod puppets are another good choice. My advice concerning the use of marionettes is...you don't want to go there.

Puppet shows are every bit as diverse as the puppets themselves, running the gamut from elaborate, large-scale productions to simple one- or two-character programs. They can stand alone or be used to supplement other activities. Puppetry offers the one-two punch of instruction and amusement—both of which are necessary, you'll remember, for effective informal education programs.

Puppetry may look like a radical departure from the more familiar slide presentation, but the rules are the same. If you want your audience to remember the message you need to develop a theme statement first and then stick to it. Work on your script before you focus on the visual support (in this case, the puppets.) And lastly, this is not child's play. A disorderly, unrehearsed puppet show is painfully obvious to your audience, who will quickly dismiss both you and the message you're trying to deliver. So don't forget to practice. Then practice some more.

Puppets add pizzazz to any informal education program. They're versatile, inexpensive, and easy to transport. They don't talk back unless you want them to. They never get tired of listening to you talk about formula and feces. And, best of all, on the way home after the show you can share all your deepest, darkest secrets—like what you really thought of the man in the second row, "who must have blown his nose, like, every 15 seconds through the entire presentation... and what was with that know-it-all in back and her color commentary, like everyone was watching Monday Night Football..."—without fear of blowing your reputation as an educator with saint-like patience. IWR

Kieran Lindsey is the former director of the TWRC Wildlife Shelter in Houston, Texas, a wildlife biologist, and president of Natural Assets Consulting. Send your comments and questions to IWRClindsey@aol.com, *or to P.O. Box 1443, Cedar Crest, NM 87008-1443.*

COLUMN

By the Book

INTERSTATE TRAVEL, PLANNING FOR THE FUTURE, WHEN IT'S RIGHT TO AMPUTATE

by Rob Lee, Special Agent, United States Fish & Wildlife Service

Q If one has an Educational permit in Texas is it a problem to take the birds to Arkansas or Louisiana for a program?

A It is not a problem to do this (i.e., it is not illegal), but it does require some effort and planning. Your Federal Special Purpose (Live Possession) Permit allows you to keep these birds at the permitted facility and use them for educational purposes anywhere in the U.S. However, you must obtain permission from each state authority you travel to or through. Some states are very restrictive about bringing wild animals in from other states. Do your homework well in advance of any anticipated travel.

Q Many rehabilitators live close to a state line. Because my state/federal permits are for MS, I refuse to cross the state line even if a case involves another state's Fish and Wildlife Department. I find I stand alone on this issue among other rehabbers, and that it is common for rehabbers to cross state lines for pick-ups, transfers, and veterinary care even when there is a vet in their own state. Please address the legality of this issue.

A This answer is similar to the previous one. If you transport a migratory bird across state lines, you must be in compliance with the laws and regulations of all states involved. If these border issues are expected, a reasonable approach would be to: (1) request that your Federal Permit authorize your activities in all the states that apply, (2) apply to each state for a permit to allow this reasonable interstate movement of animals, and (3) discuss this need with your Federal and State Permit Administrators and local enforcement officers immediately. Often, a state may simply issue a letter or give verbal authorization for these activities. Remember, your federal permit is valid only if you also possess all the appropriate state permits.

If a rescuer brings you a bird from another state you should probably accept it and notify the state of origin. Developing a good relationship with your neighboring state can eliminate questions and concerns. These are, of course, migratory birds, and they cross these artificial lines on their own every day.

Q In the event of the death of a licensed rehabilitator who holds a Special Purpose (Live Possession) Permit, what would the disposition be of the wildlife in possession? Can a simple will naming another person cover the existing license for that remaining year?

A If you truly care about what happens to these birds after you die, you should plan now. The birds you possess are not yours to will to someone else. However, it would be appropriate to leave instructions to transfer the birds to someone who has the proper facilities, experience, willingness to use them for educational purposes, and has or is able to obtain the proper federal and state authorizations. I can only imagine that the authorities would want the birds placed as soon as possible. Proper instructions in a will or other document can ensure this happens.

Q A vet in our area amputated the wing of a red-shouldered hawk and then asked me the current regulation on amputees. I have been too busy with red tape and politicians (wish it was duct tape) and don't recall the outcome of the recent discussion on this topic. I seem to remember that the regulations are confusing. Is one of these regulations stated and the other implied? Is it legal to posses an amputee as an educational bird? Is it legal to amputate the wing of a raptor?

A In an earlier column I discussed the difference between laws, regulations, and special (or standard) permit conditions. Those definitions would apply to these questions. There is no law or regulation that prohibits leg or wing amputation. Currently, Standard Condition 8 (in all Regions except 5) encourages euthanasia if wing, leg, or foot amputation is needed to treat an injury or if an animal is blind. Rehabilitators should remember that the purpose of accepting and treating migratory birds is to release them back into the wild. Amputation or blindness dooms birds to a life in confinement or a certain death if released. While waterfowl can survive amputation and release in areas that do not freeze over for long periods, few other species can. Raptors could never make it under these conditions.

Veterinarians frequently perform amputations that keep domestic pets alive and well. However, this is seldom proper for a wild animal. It is imperative to discuss this with any vet who assists you. Rehabilitation facilities should never be used to house a menagerie of disabled, nonreleasable birds. As you stated, you are already too busy to keep current on important rehabilitation issues. Don't compound this by confusing rehab with the desire to save the life of every bird that comes through your door.

Having said this, amputation may be appropriate in a very few situations. If you get a bird of a species you need for your educational programs and the bird has the right disposition and the bird can perch and feed and otherwise have a decent quality of life, then amputation may be warranted. You could then apply to add the bird to your Possession Permit.

You should never amputate because it is a "neat" bird that someone, somewhere, sometime in the future may want. We all know that the more you treat a bird and the longer you keep it the more you become attached to it. Avoid this trap by making the right—albeit, hard—decision sooner rather than later. JWR

Rob Lee has been a special agent for the USFWS for fourteen years. Prior to that he served as a refuge manager with USFWS for eight years. He is a certified wildlife biologist and has a MS in biological science from California State University, Sacramento. Send comments and questions for Rob Lee to runmuki@earthlink.com.

COLUMN

Food for Thought

MICRONUTRIENTS—PART II: ANTIOXIDANTS ET AL.

by Astrid MacLeod and Janine Perlman

In this installment of Food for Thought, we examine an array of micronutrients that function as **antioxidants.**

In chemical terms, when a molecule is **oxidized,** it loses one or more electrons. We live in an atmosphere that is rich in the gas oxygen, which is a potent oxidizer, or "grabber" of electrons. Molecules that do not have a strong hold on their own electrons, including many of those in an animal's body, are more or less easily oxidized. Oxidation can be as slow as rust (the oxidation of the element iron) or as fast as the explosion of dynamite (in which nitroglycerine combines very rapidly with oxygen).

The term ***antioxidant*** has a well-founded positive connotation. One might assume, then, that if *anti*oxidants are "good," the process that they're "against," ***oxidation***, must be bad. That is decidedly not so.

Most biological oxidation reactions are extremely well controlled by enzymes, and they are essential to survival. Some of them create new and useful biochemicals for structural or functional uses in the animal's body. Other oxidation reactions harvest energy needed for heat and locomotion. We are all familiar with the notion that animals need oxygen in order to "burn," or oxidize, their food, and we are very familiar with the fact that even a brief lack of oxygen causes death. That is an indication of the centrality of oxidation reactions to life.

However, while oxidation must take place continuously, there are also "renegade" events that can cause damage. A few kinds of harmful oxidations have been well characterized. One type occurs when high-energy particles or radiation, such as gamma rays or X-rays, cause reactions leading to the oxidation of DNA. Mutations can result, leading to cancer. Exposure to ozone, some medications, and a variety of chemicals can also produce oxidizing agents.

The body can generate its own oxidizers, too. For example, some white blood cells "eat" pathogens and then, in a "respiratory burst," release chemicals including hydrogen peroxide (the same as the drugstore antiseptic) to kill the invaders. Bodily trauma or injury results in similar processes.

In addition to DNA, common targets of oxidation include proteins and polyunsaturated fatty acids found in cell membranes and circulating lipoproteins. When lipoproteins, circulating in the blood, are oxidized, they are more prone to form plaques on arterial walls, leading to atherosclerosis. This condition predisposes people and other animals to heart attacks, stroke, and other thrombotic (clot-caused) cardiovascular accidents.

Common culprits in undesirable oxidations include *free radicals*. They and other oxidizers are generically termed *reactive species*. In reactive species, electrons are in a high-energy, or unstable and reactive, state. To become more stable, they often require another electron to form a pair. Hence, reactive species "grab" an electron or a hydrogen atom (which is an electron plus a proton) from another molecule. In such a case, once a hydrogen atom has been taken from a molecule, that molecule then has an unpaired electron, and has, itself, just become a high-energy free radical. Thus a *chain reaction* is initiated, in which oxidation by free radicals creates more free radicals. Damage to cells and tissues can quickly occur.

Antioxidants donate electrons or hydrogen atoms to the "grabby" reactive species, thus stabilizing otherwise dangerous oxidizers. The antioxidant does not, however, become a reactive species itself—instead, other biochemicals donate electrons or hydrogen atoms to it in controlled reactions, and the antioxidant is regenerated, to be used again.

You may be wondering about the fact that there must always be molecules available to donate electrons, in order to regenerate antioxidants. Why don't animals run out of "donate-able" electrons and become completely oxidized? Ultimately, it's because plants harvest the energy of the sun and create foods that store the energy as donate-able electrons. Foods are eaten, and their energy is stored by the body in "high-energy" biochemicals, using tightly regulated reactions. Some of those high-energy biochemicals are electron donors used in regenerating antioxidants.

The role of antioxidants in harm prevention can become visible when an animal is severely deficient in an antioxidant. For example, when an animal is extremely deficient in the antioxidant vitamin E or selenium, cell membranes are so badly oxidized that they become leaky, and pathological edema may become obvious.

There are two general kinds of chemical environments in the body: water-soluble (as in blood plasma, and fluids within and between cells) and fat-soluble (as in membranes, and lipoproteins in blood). Antioxidants are present, and needed, in both types of environment.

As described earlier, membranes and lipoproteins may become oxidized, with deleterious effects. Antioxidants that prevent this must be fat-soluble so that they are in the immediate vicinity of the vulnerable lipids.

Examples of **fat-soluble antioxidants** include glutathione, coenzymeQ_{10}, vitamin E, alpha-lipoic acid, vitamin A, and carotenoids. **Glutathione** is a tripeptide (made of 3 amino acids), while **coenzymeQ_{10}** (CoQ_{10}) and alpha-lipoic acid are lipid-like molecules intimately involved in the harvesting of energy from the oxidation of glucose. Although these three antioxidants are made by animals, supplementation with CoQ_{10} has been found to improve heart function in people with cardiomyopathy (diseased heart muscle), and to enhance the performance of athletes, while alpha-lipoic acid is a versatile and powerful antioxidant that appears to have therapeutic effects for certain diseases when taken as a supplement. **Vitamin E** is a molecule with one end

having a structure like a fatty acid. The other end can donate a hydrogen atom to free radicals. It is made exclusively by plants and is particularly plentiful in the oils of seeds and nuts.

Vitamin A is made in nature only by animals. It has several forms: retinal, retinol, and retinoic acid. These are also crucial for specific non-antioxidant functions, such as vision; these functions will be addressed in future columns. *Provitamins* A are **carotenoids**, made only by plants. There are more than 600 known carotenoids, of which only a small subset are provitamins A. A well-known example is beta-carotene. Provitamins A can be made into vitamin A by many animals; however, true carnivores are not able to make this conversion, and they require animal-derived vitamin A. Other carotenoids have different known functions, such as providing the amazing colors of birds, while many carotenoids have not yet been well characterized. Vitamin A and carotenoids have a lipid-like structure. Carotenoids are found in fruits and vegetables, and they are further specifically modified by animals that consume them. Each food contains a specific profile of carotenoids, so providing animals the widest possible variety of natural foods will offer them a needed spectrum of these important nutrients.

The antioxidant properties of vitamin A and carotenoids stem from the arrangement of their electrons, which is large and complex. It might be visualized as a big, soft cloud. This set of electrons can easily accept extra energy from a reactive species. Then, rather than becoming a reactive species itself, the antioxidant molecule dissipates the extra energy as heat.

Water-soluble antioxidants include **uric acid** (a small molecule that is the product of nitrogen metabolism, and an excess of which results in gout), **glutathione** (described above; soluble in both aqueous and lipid environments), and **vitamin C**. Vitamin C, or **ascorbate**, was described in the previous Food for Thought. Its structure resembles a sugar. Although most animals manufacture ascorbate, growth or stress due to injury, illness, or captivity often results in a deficiency of this nutrient. Supplementation is almost always advisable.

Flavonoids are another class of phytochemicals, or chemicals made by plants. There are many more flavonoids than carotenoids. Most of the colors seen in fruit and flowers are owed to these chemicals. It is emerging that many flavonoids are also antioxidants, as judged by their actions in the test tube. Epidemiological studies show that people who eat, for example, more catechins (one kind of flavonoids), appear to have less heart disease. Catechins are present in foods as disparate as chocolate, tea, and apples. It is thought that specific flavonoids may act as antioxidants in rather specific areas of cells and tissues. The lesson once more is that plants (and animals) contain literally thousands of chemicals, the nature of which we are only beginning to understand. A varied, natural diet is an essential part of good care in wildlife rehabilitation.

There are nutrients that play auxiliary, but still essential, roles in antioxidant reactions. So, for example, in addition to chemicals (antioxidants) that donate electrons, there are enzymes that facilitate such transfers. Such enzymes may have mineral cofactors; examples include **iron, zinc, copper,** and **manganese**. Foods of animal origin are the richest sources for all of these except manganese. Unlike vitamins, minerals are extremely stable in storage.

As noted, antioxidants need to be regenerated for reuse. A number of nutrients serve as **coantioxidants**, or substances that are necessary for the antioxidants to be regenerated. For example, the regeneration of glutathione requires an enzyme that, itself, requires the mineral **selenium** as a cofactor. Selenium is the most toxic of the microminerals for many animals. It was responsible for widespread teratogenesis (birth defects) in waterbirds living in areas that drained irrigation from the selenium-rich soils of California's Central Valley. Yet there are many areas of the world in which the soils, whence comes the mineral in the food supply, are very poor. Both selenium toxicity and selenium deficiency, depending on the soils and plants, have been observed numerous times in humans, and in domesticated and wild animals.

The regeneration of vitamin E requires ascorbate, CoQ_{10}, glutathione (and therefore selenium), and **niacin** (a B vitamin also described in the previous Food for Thought column). The regeneration of vitamin C requires glutathione and niacin.

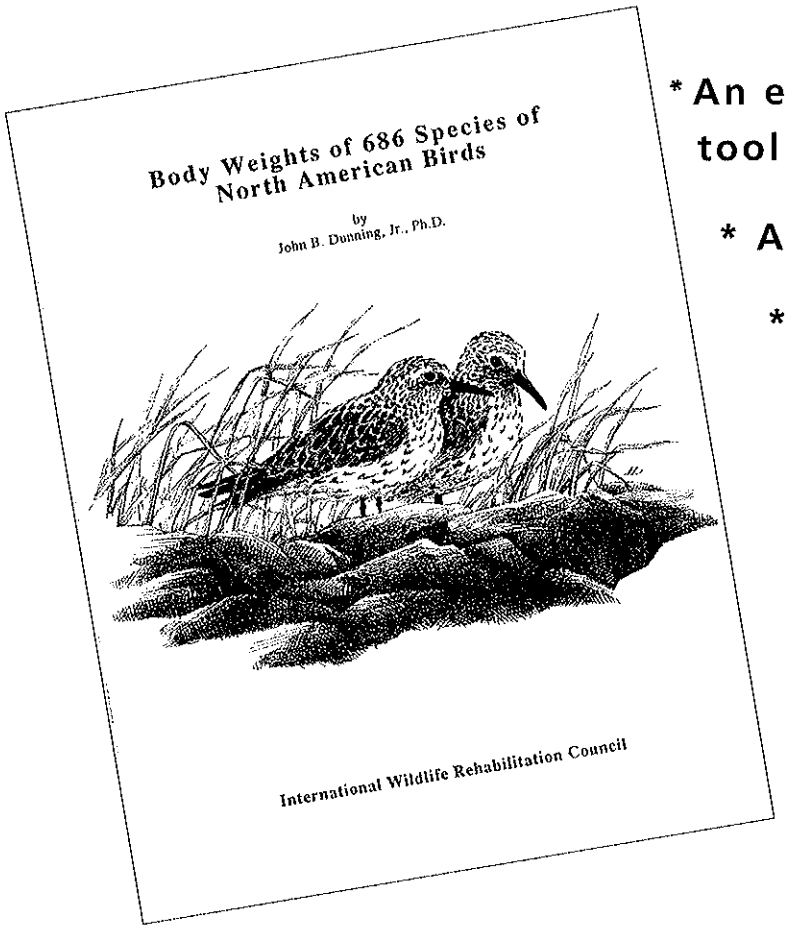
The discerning reader may (or may not) be wondering by now where this all ends. In fact, there is no end to it, because every biochemical reaction in the body is related, whether closely or distantly, to every other. Every process in the body is interdependent on every other one. Every end product of one reaction is the starting ingredient for another. The biochemical web of a single life is as complex as the ecological web in which the organism lives. For optimum health, the foods that captive animals eat must offer a similar complexity of nutrients. JWR

The authors welcome feedback and suggestions for future topics. Please feel free to contact them.

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Body Weights of 686 Species of North American Birds
by John B. Dunning Jr, PhD

Knowing the normal weight of an animal is essential when assessing body condition. Dr. Dunning has kindly allowed IWRC to reprint this monograph, originally published by the Western Bird Banding Association. Standard and normal ranges are provided by species. An invaluable resource tool for anyone who works with birds.

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Conservation Classics: *The Origin of Species*

by Charles Darwin
Reviewed by Kieran Lindsey

New York.: Bantam Classics, 1999
First published in 1859
480 pp; U.S.$5.95
ISBN: 0553214632

Mark Twain once defined a literary classic as a book that everyone praises and no one reads. Charles Darwin's seminal work, *The Origin of Species by Means of Natural Selection or The Preservation of Favoured Races in the Struggle for Life*, fits one half of that definition: few people have actually read the book. That hasn't kept just about everyone from forming an opinion on it, though. Seldom has a publication been the focus of such a maelstrom of controversy.

Charles Darwin was born in Shrewsbury, England, in 1809. He attended Edinburgh University and Christ's College in Cambridge; upon receiving his degree, he embarked on a five-year voyage aboard the H.M.S. *Beagle* as a naturalist. The bulk of his life was devoted to publishing the data collected during this voyage and in documenting his theory of the transmutation of species. The book was received with violent and malicious criticism.

Although he wasn't the first person to champion natural selection as the mechanism by which species originate, Darwin was the first to publish a convincing argument supporting this theory. He originally intended the book to be little more than an introductory statement to a 20-volume treatise on evolution, but he died before realizing that goal. (Procrastination was a bit of an issue for Darwin, although he would probably have deemed this characteristic "prudence.") He had gathered a massive amount of supporting evidence during his visits to the Galapagos Islands—on variability, sexual selection, and dispersal—but sat on the data until practically forced into publishing by the fact that another naturalist, Alfred Russel Wallace, was on the verge of beating him to the punch.

In spite of claims to the contrary, Darwin did not propose that man is cousin to chimpanzees and gorillas. In fact, at the time of publication the greatest cause for scandal was the naturalist's claims challenging contemporary beliefs about Divine Providence and the fixity of species—an interpretation of the Bible that maintains that every kind of animal living on Earth was placed there by God, perfect and in its final form, at the time of Creation. Darwin theorized that species derive from other species through a gradual process of natural selection. And while Darwin did not speculate on the religious ramifications of this theory, it was interpreted by many people as proof that the Bible was wrong, and that such a theory provided evidence for the nonexistence of God.

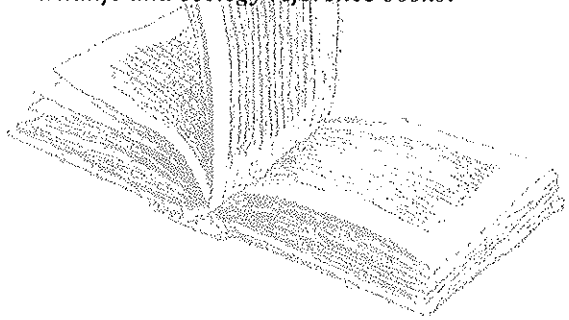
The book had other detractors, not about the information contained within it, but for the style in which that information was presented. Darwin himself remarked, upon reading the published version, that he found it "tough going." And yet *Origin of Species* is commonly lauded by contemporary critics as one of the most readable accounts of scientific theory ever published. In fact, Darwin's calm, reasoned, unrhetorical tone held to a higher standard than generally required at the time. Too calm and reasoned, perhaps, for such an adventurous set of ideas, although he found he could rise to the occasion, as in this famous passage on the struggle for existence:

> When we look at the plants and bushes clothing an entangled bank, we are tempted to attribute their proportional numbers and kinds to what we call chance. But how false a view is this!...What a struggle between the several kinds of trees must have gone on during long centuries, each annually scattering its seeds by the thousands; what war between insect and insect—between insects, snails, and other animals with birds and beasts of prey—all striving to increase, and all feeding on each other or on the trees or their seeds and seedlings, or on the other plants which first clothed the ground and thus checked the growth of the trees! Throw up a handful of feathers, and all must fall to the ground according to definite laws; but how simple is this problem compared to the action and reaction of the innumerable plants and animals which have determined, in the course of centuries, the proportional numbers and kinds of trees now growing...."

Another problem for the modern reader is that the book is filled with clichés. Rather, much of what Darwin has written has become a cliché, however fresh and innovative ideas like "survival of the fittest" and "struggle for existence" were at the time of publication. It can be difficult to keep in mind how groundbreaking this work was, and therefore lose sight of how daring these ideas were when first proposed.

For all that *Origin of Species* is a true classic within the field of conservation, the beginning of an enormous paradigm shift. Those who expect a flawless, up-to-the-minute discussion of evolutionary theory will be disappointed. Much has been discovered since, and the motivated reader would be well served to follow Darwin's text with something more modern, such as Richard Dawkin's *The Selfish Gene*. Reading two densely scientific tomes may seem a lot to ask anyone who isn't, at the very least, a college biology major, but the results would be well worth the effort—no less than a basic understanding of the underpinnings of the ecology of animals and plants. JWR

Conservation Classics is intended to provide our readers with suggestions for building a collection of must-have wildlife and ecology reference books.



Birds! From the Inside Out

Written by Dan Gleason
Illustrated by Barbara Gleason

Dancing Crane Images and Education (3125 Onyx St., Eugene, OR 97405), 2000 (second edition)
161 pp; U.S. $18
ISBN: [forthcoming]

I've long maintained, and was probably taught, that the best way to understand something is from the inside out. If we know how something is constructed, we're most likely to be able to figure out why it functions the way it does. If we know the crystalline structure of ice, we can understand how this apparently dense solid is able to float on its (apparently less dense) liquid form: water. Of course, in animals, both the *how* and *why* contribute to patterns of behavior that, over extended periods, all become part of the big evolutionary picture that results in the modern organism.

Dan Gleason has digested structure, form, function, and behavior of birds of North America into 161 interesting and readable pages. Though he may mention color and plumage when discussing mating behavior, for example, he has chosen to elaborate on many less obvious characteristics—for example, how monogamy, the various forms of polygamy, promiscuity, and leks may benefit each species. I don't mean to imply that color and identification of species are neglected. A bibliography from Attenborough to Weidensaul and Welty are suggested reading, including the premier names in ornithology: Erlich, Johnsgard, Peterson, Skutch, Stokes, and Terres. What I do mean to point out is that, for rehabilitators, the variety of toe arrangements and how they influence a lifestyle are often more important in establishing identification than color, particularly for juveniles. Barbara Gleason's illustrations depict these differences with nice clarity. Her portraits are captivating, from the marsh wren declaring his dominion to the eye lashes on a young burrowing owl.

A chapter on the advantages and disadvantages of migration vs. overwintering precedes the chapter on facts and misconceptions regarding the feeding of wild birds. Most of this is good sensible advice, though I question the absolute warning against artificial sweeteners for hummingbirds. In my experience you can offer as much saccharine and aspartame as your dietetic heart desires. After one taste the birds will ignore it altogether and exploit the other resources in the area. Much as we like to feel altruistic and needed, feeders really function more for our benefit—they bring the birds into our range of view—than for the benefit of the birds. Birds, after all, evolved before feeders were developed.

I particularly liked the chapters on flight, skeleton, and respiration. We talk about birds flying, getting lift, soaring, stooping, and so forth. But what does this really mean? Why can't we do it? If we had feathers...uh uh, probably not. Flight involves a complex interaction of physical, and chemical principals both within the organism (structural and physiological) and in the environment. One can't soar high if one can't find rising air. Where is rising air found? How can big seabirds soar so close to the waves? And how can the body acquire enough oxygen to burn the fuel required to drive the engine of flight? It's all clearly depicted for us mammalian landlubbers.

Forty-three pages of additional supplemental material comprising a description of families of North American birds, subgrouped under orders, and an enlightening dictionary of ornithological terms rounds out the volume. I know a cob is a male swan, but what is the female called? It's there. I found great, useful, words like "pterylae" and "apteria"; and more, like "pterylography" and "pterylosis" (nope, not a disease). One can learn a lot about Latin and Greek roots by paying attention, and it's fun! JWR

Reviewer Penny Elliston is the president of Wildlife Rescue, Inc. of New Mexico.

The Food Revolution

by John Robbins

Berkeley: Conari Press, 2001
340 pp; U.S. $17.05
ISBN: 1573247022

You may not think about it often, but eating is a profoundly political act. According to John Robbins' new book, *The Food Revolution*, the American diet is the cause of misery both at home and throughout the world. Not only are Americans among the most unhealthy people in the world, but their insistence on eating high on the food chain leads to an ongoing slaughter of animals, world hunger, and the depletion of irreplaceable natural treasures, such as water and rain forests.

The overall structure of Robbins' book is straightforward. Broken into large themes, the book begins with a critique of the American diet from a health perspective; this section alone is worth the price of the book. Other themes include the conditions under which animals are raised and slaughtered and the alienation that comes with treating animals as just another "product." The second half of the book focuses on the environmental and political effects of poor food choices. The book concludes with a stinging critique of the ongoing efforts to create genetically engineered plants and animals.

The treatment of animals on factory farms, as detailed by Robbins, is horrific. Ninety-nine percent of the chickens that lay eggs in this country are debeaked. Pigs crammed into small spaces become aggressive and bite at each other's tails, so agribusiness employees chip their teeth and cut off their tails (without anesthesia). Bessie the milk cow, who today produces more than twenty times the amount of milk that a cow naturally produces, is increasingly tied into her stall. Meat cows are treated even worse. Despite regulations that require cows to be stunned into unconsciousness, one factory worker estimates that at least thirty percent of the animals at his factory are awake during the first stages of butchering.

Robbins details the political and social impact of eating meat and dairy products. He points out that Guatemala, a country in which 75% of children younger than four years are malnourished, exports 40 million pounds of meat per year to the U.S. In Mexico, another country plagued by food uncertainty, half of the grain grown is consumed by livestock. As wealthier people throughout the world imitate American consumption habits, pressure on grain supplies is steadily increasing, causing even more food insecurity among the world's poor.

The counterpoint to the suffering that Robbins catalogs is governmental and corporate arrogance, corruption, and short-sightedness. Robbins details efforts of a House representative trying to pass a bill that would permit the USDA to fine companies for unsanitary conditions in meatpacking factories. The House Appropriations committee rejected the proposal by a vote of 25 to 19. The 25 who voted against the proposal had received six times the campaign contributions from the meat and dairy industry as those who voted for it. Instead of protecting meat (for those who wish to continue eating it), the industry continues to press for increased irradiation of food. "Consumers should be glad we're doing it," says one executive. "People should just relax and trust us to know what we're doing."

Next, Robbins tackles "genetic engineering" as an answer to world hunger. If genetic engineering is as safe as the agribusinesses claim, Robbins asks, has why no insurance company to date been willing to insure the industry? And, given agribusiness' professed interest in feeding the hungry, it is also difficult to understand why, although almost 100 million acres of land were planted with transgenic crops in the year 2000, "No commercial acreage had been planted in crops which had been engineered to produce greater yields or that had any kind of enhanced nutritional value.... In fact, the majority of the fields were growing transgenic soybeans and corn that were destined for livestock feed."

Robbins' arguments—that our acquiescence to corporate agribusinesses and our lack of care and love for other creatures and the planet are unsustainable and morally wrong—are generally clear and compelling. Occasionally, however, he wanders off into a forest of star-studded irrelevance. For example, he mentions his connections with River Phoenix, Linda McCartney, and John Denver again and again. While I have little doubt that these people were fine, upstanding, vegetarian human beings, I can't say that his relationships with them mean much in the broader context. Robbins also puts out a bit too much New Age, feel-good psychobabble for this hard-headed Midwesterner. (What's wrong with being angry?) And, finally, I felt that one group was truly forgotten: Robbins didn't mention, even once, how the meat and poultry plants routinely dismember those who work in them. Despite its problems, however, the book is a worthwhile and enlightening read, and I recommend it highly to anyone with an interest in health, animal rights, and environmental sanity. JWR

Reviewer Patty Jane Lemley is an environmentalist and an animal advocate in Washington, D.C.

NEWS BRIEFS

Food Handling Manual Available

The United States Department of Agriculture's Animal Welfare Information Center (AWIC) recently published *Handling Frozen/Thawed Meat and Prey Items Fed to Captive Exotic Animals—A Manual of Standard Operating Procedures*. Free copies may be obtained by e-mailing AWIC at awic@nal.usda.gov or faxing a request to AWIC at 301/504-7125. Please include your name and mailing address. Bulk orders are not accepted.

Audubon Launches IBA Program

The National Audubon Society has launched the U.S. component of a unique international effort, the Important Bird Areas (IBA) program. The IBA program uses local volunteers to identify critical bird habitat. Nominated sites are reviewed by leading scientists, and then endorsed by Bird Life International, which is headquartered in Cambridge, England. (Audubon is the BirdLife's partner for the program in the U.S.)

The sites' continued health is assured by local land managers and landowners. The program imposes no regulations, restrictions, or costs. Private lands can be nominated for inclusion only if the owner is in full agreement.

Many birds that use U.S. flyways spend parts of each year in Canada, Mexico, and Latin American countries.

"Through stressing action by people at the local level, the IBA program offers ordinary Americans an opportunity to protect globally important places and help save the birds that use them from decline and extinction," noted John Flicker, Audubon president and CEO.

Audubon's initial list of selected global IBA nominations is available at www.audubon.org/news/release/iba_list.html. By the end of 2002 Audobon will have programs underway in all 50 states, with more than 3000 sites designated.

Group to Safeguard Environment

U.S. lawmakers can now find help from a new Internet-based information clearinghouse for environmental legislation. The State Environmental Resource Center (SERC)—a collaborative project of Defenders of Wildlife and the Natural Resources Defense Council—will work state-by-state to help legislators promote pro-environment legislation to safeguard the public health, air and water, wildlife, and wild lands.

"Americans have long looked to Congress to protect the environment," SERC National Director Andy Gussert said. "But concerned citizens are now appealing to public officials closer to home. SERC can help progressive state lawmakers across the country." To learn more, visit www.serconline.org.

Iran Struggles to Prevent Extinction of Persian Asses

The wild Persian ass has long been celebrated in art and literature. But unless a desperate effort succeeds to save its dwindling numbers, the animal could completely disappear in Iran. No more than 400 of these animals remain on the planet. They have become a symbol of wildlife conservation in Iran.

In the chaotic years following the 1978 revolution, outside the political turmoil of the cities, uncontrolled hunting and habitat destruction devastated wildlife across this country. Over a short period of time, 90% of the wild ass population was lost. The survivors now are restricted to only two sustainable populations in widely separated reserves.

Four and a half years ago the government launched a special rescue project for the wild ass, capturing a few of the animals and transferring them to a fenced enclosure near Yazd. Akbar Hamadanian, the project director with the department of environment, admits they made some mistakes in their operations. Some of the animals have died. But this program is the first in Iran that has experimented with wild capture in

this manner. And the six animals in the enclosure are now breeding successfully and could help to save the wild ass from extinction. In a few years, program officials plan to release this herd into a large protected reserve beyond its enclosure, hopefully establishing a third wild population of the endangered animals.

The Persian wild ass is only one of six subspecies of the Asiatic wild ass that was once common across central Asia and the Middle East. The Syrian subspecies is already extinct.

Budget Would Harm Environment

In the U.S., the Bush administration is proposing sharp budget cuts in environmental initiatives for the coming fiscal year. The budget, unveiled in February 2002, boosts oil and gas development on public lands while shortchanging endangered species protections, wildlife refuges, and the Land and Water Conservation Fund, which helps save wildlife habitat and other cultural treasures. "The White House claims we have to weaken environmental protections to fund more Pentagon spending, but there's no shortage of money in this budget for the fossil-fuel industry to produce more smog, soot, and global-warming pollution," Defenders of Wildlife President Rodger Schlickeisen said.

For an analysis of the impact of the budget on environmental protection, visit www.defenders.org/publiclands/fy03.pdf.

USGS Manual Now Online

The USGS National Wildlife Health Center's *Field Manual of Wildlife Diseases* is now available on the Internet at: www.nwhc.usgs.govpub_metadata/field_manual/field_manual.html.

It can be downloaded as one file or by individual chapters, all in Adobe PDF format.

West Nile Tests Turn Up More Bird Deaths from Poisons in New York

While testing for the presence of West Nile virus, postmortems on up to 250 birds a day have uncovered a surprise: more birds are dying from pesticides, herbicides, and lead than from the virus. In the fiscal year ending 31 March 2001, laboratories in the Five Rivers Environmental Center identified 1263 birds carrying West Nile virus. During the same period, 1953 birds were identified as dying of toxins from pesticides like Dursban, a chemical banned by the U.S. Environmental Protection Agency (EPA), and Diazanon, which the EPA ordered taken off the market in a year and a half. In addition, lead poisoning is taking a toll, often on birds of prey that ingest fishing sinkers or carrion killed by lead shot or pellets.

Naturalists Share Findings Online

A December 2001 *New York Times* article by James Gorman reports that the interactive online database is the latest identification and tracking tool for amateur naturalists, birders, and butterfly watchers who wish to help professionals gather bird and butterfly data.

"We are in the midst of a sea change in the way people view themselves in relation to the environment," noted John W. Fitzpatrick, director of the Cornell Lab of Ornithology, "and technology is making the difference."

Several conservation organizations are promoting a variety of "citizen science" projects that make use of amateur observations. One of the first such projects, the annual Audubon Christmas Bird Count, dates back a century. In recent years a number of new efforts have been started, all based on the capacity of the Web both to receive data and to display it quickly and clearly.

A bird-watcher can enter the sighting of a cardinal at the backyard feeder or a kettle of hawks over a nearby mountain directly on a home computer. Analyses of the data are available in tables, maps, and other forms, so contributors see how their data is being used.

Events such as the Great Backyard Bird Count have "motivated people to be outside and connected with birds at home in a way they wouldn't have otherwise," notes the Audubon Society's Dr. Frank Gill.

The Cornell Lab and the Audubon Society have a cooperative website called Bird Source (www.birdsource.org), where most of the data gathered can be seen. The website offers a rich interactive stew of information, similar to the habitat and migration maps found in bird guidebooks, but dynamic.

Climate Change Threatens Wetlands

A new report from the Pew Center on Global Climate Change warns that global warming could devastate lakes, streams, rivers, and wetlands throughout the U.S. The report, which reviewed more than 150 scientific studies on climate change, concludes that rising temperatures could make some water too warm for the fish and other creatures that now live in them. To reach waters cool enough for survival, some species may have to travel more than 400 miles north. Log on to www.pewclimate.org/projects/aquatic.cfm to read the report.

Data on Effects of Fishing Sought

The Henderson State University Department of Biology is conducting research concerning the effect of lost or discarded fishing baits on wildlife. The project was conceived when university biologists recently discovered two local cases in which raccoon latrine sites contained pieces of plastic worms that apparently had passed through the animals' digestive tracts.

The researchers are interesting in receiving general information from rehabilitators who have treated cases in which waterfowl, mammals, or other species that have become entangled in fishing line, hooks, etc., have required care. Information sought includes the species affected, the nature of the problem (hooks in beaks, mouths, feet, etc., kinds of baits if known, problem with bleeding, infection, or ingestion), and the outcome (release, death, etc.). Ultimately, the researchers hope to present their findings in presentations and through publication in the *Journal of the Arkansas Academy of Science*. Any assistance is greatly appreciated and will be acknowledged in the paper. Please e-mail records or other information to tumlison@hsu.edu, or send via traditional mail to: Renn Tumlison, Department of Biology, Box 7861, Henderson State University. Arkadelphia, AR 71999, USA.

Fighting Off-Shore Oil Development

One-tenth of the surviving population of southern sea otters lives where the Bush administration has proposed allowing oil drilling off the California coast. California Gov. Gray Davis has vowed to stop the development of the 36 drilling leases granted by the federal government. California Resources Secretary Mary Nichols said the poor-quality oil in the leases is "closer to asphalt than something that you'd put in your car" and deadly to ocean life. To learn more, go to www.saveseaotters.org. JWR

MAMMALS

Serologic Survey of Selected Viral Agents in Recently Captured Wild North American River Otters (*Lontra canadensis*)

Kevin R. Kimber et al.

J. Zoo and Wildlife Med. 2001. 31(2)

Blood samples were collected from 64 wild North American river otters (*Lontra [Lutra] canadensis*) from northern and eastern New York state and analyzed for serologic evidence of exposure to selected viral agents during a 1995–96 translocation program. No clinical signs of disease or lesions suggestive of prior viral exposure were seen. Titers were detected for antibodies against canine distemper virus, canine herpesvirus-1, and canine parvovirus-2, but not for antibodies against canine adenovirus-1, canine coronavirus, canine parainfluenza virus, rabies virus, feline herpesvirus-1, feline calicivirus, or feline coronavirus. This is the first report of titers for antibodies against canine herpesvirus-1 in North American river otters, and it suggests a low prevalence of antibody titers against most canine viruses in otter populations in the study area. Confounding variables in this study could include exposure to domestic dogs associated with the project, prolonged time spent in captivity, and concurrent bacterial or parasitic infection. Stress-associated humoral immune suppression could have altered serologic profiles, especially in otters exposed to dogs after trapping but before venipuncture.

Sarcocystis Neurona-Like Encephalitis in a Canada Lynx (*Felis lynx canadensis*)

Thomas W. Forest et al.

J. Zoo and Wildlife Med. 2001. 31(3)

A 13-year-old female Canada lynx (*Felis lynx canadensis*) died after a short clinical illness, and necropsy revealed multifocal, nonsuppurative encephalitis with protozoal schizonts present in cerebral vascular endothelial cells. The schizonts stained immunohistochemically with antiserum to *Sarcocystis neurona*. This is the first report of *Sarcocystis* encephalitis in the Canada lynx.

AVIAN

Daily Energy Expenditure of Nestling Bald Eagles in Northern Wisconsin

Cheryl R. Dykstra et al.

The Condor, 103(1): 175–79

The authors measured field metabolic rate of nestling bald eagles (*Haliaeetus leucocephalus*) in northern Wisconsin, using doubly labeled water. In inland northern Wisconsin and along the Wisconsin Lake Superior shore, eaglets aged 39–60 days, weighing 3.08–4.85 kg, expended an average of 2,427 ± 100 kJ day^{-1}. Nestling field metabolic rate was weakly correlated with nestling age, but not with mass. Field metabolic rate of eaglets can be used to estimate the biomass of food that adult eagles must provide from their environment, a datum that is important for determination of habitat suitability.

A Comparison of Noninvasive Techniques for Estimating Total Body Fat in Sharp-Shinned and Cooper's Hawks

John P. DeLong and James A. Gessaman

J. Field Ornith. 2001. 72(3)

The authors evaluated the use of three direct methods (fat scoring, condition indices, and multiple regression of external morphological variables) to estimate total body fat (TBF) in sharp-shinned hawks (*Accipiter striatus*) and Cooper's hawks (*A. cooperii*). All three methods explained more than 82% of the variation in actual TBF values, and all three methods required the use of multiple equations to account for the categories of species, age, and/or sex. The authors also evaluated an indirect method that estimates TBF by the difference between actual mass and estimated lean mass. Lean mass was estimated using a multiple regression of external morphological variables, and this technique was fairly accurate (r = 0.94). The methods evaluated here, though reasonably precise, may not be accurate enough to reliably compare estimated TBF between individual birds. Using multiple regression to directly estimate TBF from mass and tarsus length measurements is the recommended technique because (1) it provides continuous estimates of TBF; (2) it requires measuring only two external morphological characters, both of which are less subjective than fat scores; and (3) it is more explanatory than the other two methods, which use external characteristics as predictors. The results also suggest that comparing groups of birds using condition indices may yield misleading results because these indices can relate to TBF differently for species, age, and/or sex classes.

Ingestion of Lead and Nontoxic Shotgun Pellets by Ducks in the Mississippi Flyway

William L. Anderson et al.

J. Wildlife Mgmt. 64(3):848–57

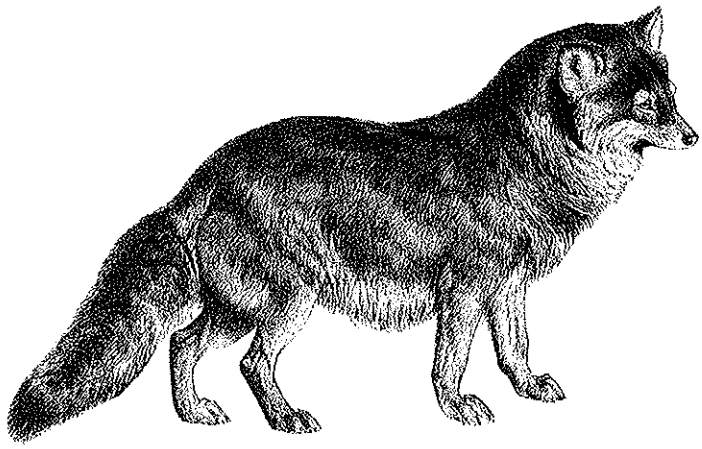
The authors examined the extent to which ingested nontoxic (steel and bismuth-tin) shotgun pellets replaced toxic (lead) pellets in ducks harvested in the Mississippi flyway during the 1996 and 1997 hunting seasons (fifth and sixth year after nationwide conversion to nontoxic shot). Gizzards were collected from 16,651 ducks and processed for the presence of pellets. Prevalences of ingested pellets were 8.9% for 15,147 mallards (*Anas platyrhynchos*), 12.7% for 749 ring-necked ducks (*Aythya collaris*), 4.3% for 579 scaups (*Aythya affinis* and *A. marila*), and 9.7% for 176 canvasbacks (*Aythya valisineria*). For gizzards with ingested pellets, as much as 68% of mallard, 45% of ring-necked duck, 44% of scaup, and 71% of canvasback contained only nontoxic pellets. The authors estimated that nontoxic shot reduced mortality from lead poisoning in Mississippi flyway mallards by 64%. Ingestion of ≥2 toxic pellets declined by as much as 78%. To the extent that these findings apply to other species and flyways in North America, an estimated 1.4 million ducks in the 1997 fall continental flight of 90 million were spared from fatal lead poisoning. Only 1.1% of 1318 gizzards positive for shot-in pellets came from ducks shot with toxic pellets, and only one toxic fishing sinker was found in the 16,651 duck gizzards.

JWR

DITTO A REPRODUCEABLE PUBLIC SERVICE ANNOUNCEMENT

COEXISTING WITH...

COYOTES



Coyotes are extremely adaptable. They are the only large wild predator that has extended its range despite human intrusion into habitat...they now live in rural and urban areas from California to Maine, from alpine to desert habitat.

Coyotes come into heat once a year in late winter or spring. About two months later they bear roughly six pups, which begin to emerge from the den about two weeks later.

They are less social than wolves or domestic dogs and usually hunt alone, although they sometimes hunt in pairs for larger prey.

Coyotes are carnivores, and opportunistic. 90% of their diet is meat, carrion, mice, rats, ground squirrels, marmots, prairie dogs, other rodents, and the occasional bird. Any environment that attracts small rodents will, in turn attract coyotes.

So, since we all live in coyote country...

- CLOSELY SUPERVISE SMALL CHILDREN, DOGS, AND CATS AND KEEP THEM IN, ESPECIALLY AT DUSK AND DAWN.
- ELIMINATE HIDING COVER in landscaping and dwellings. Make it difficult for coyotes to approach unseen.
- INSTALL OUTSIDE MOTION DETECTORS.
- Predators follow prey. STORE GARBAGE, GRAINS, PET FOODS, AND OTHER ITEMS THAT ATTRACT RODENTS SECURELY. Feed pets inside; don't allow a build-up of uneaten bird seed near human residence.
- IF YOU ARE CONFRONTED... stay calm, look big and tough, and back away. Remember, a friendly coyote is eventually a dead coyote.

This space for your organization's name, address, website, and phone number.)

Ditto concept and copy provided by the New Mexico Department of Fish and Game.

TAIL END

by Astrid MacLeod

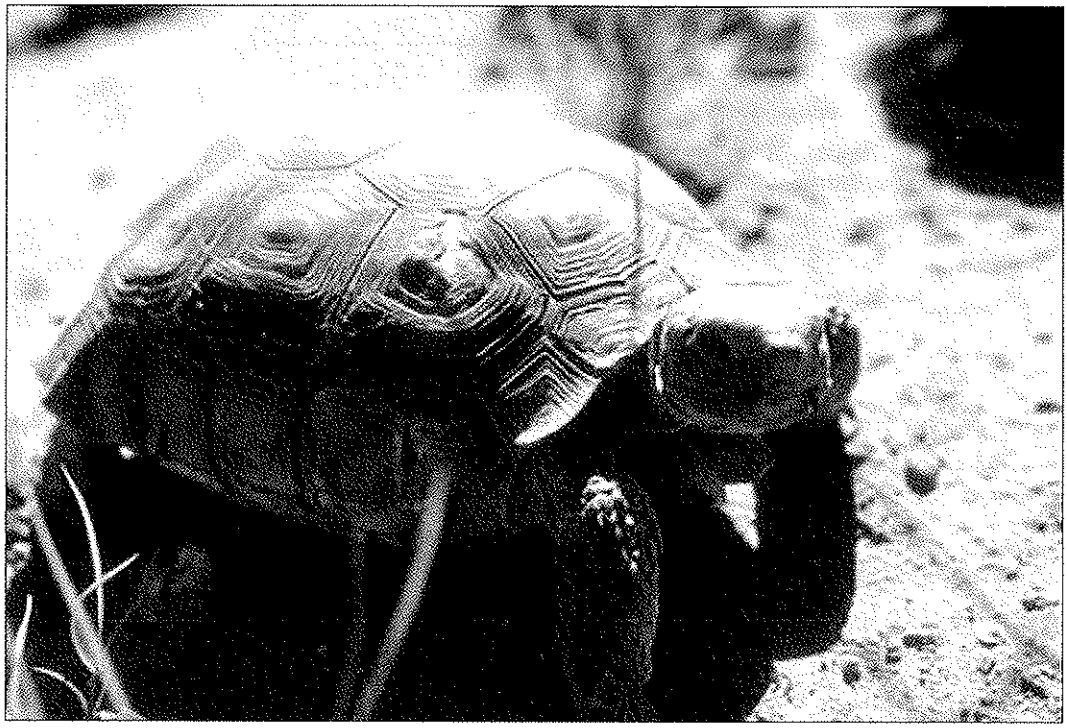


PHOTO: DESERT TORTOISE (*GOPHERUS AGASSIZII*) ©1997 THE LEARNING COMPANY, INC.

Well, Ted...what do you think?
It was either this or aluminum siding.

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