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JOURNAL OF WILDLIFE REHABILITATION

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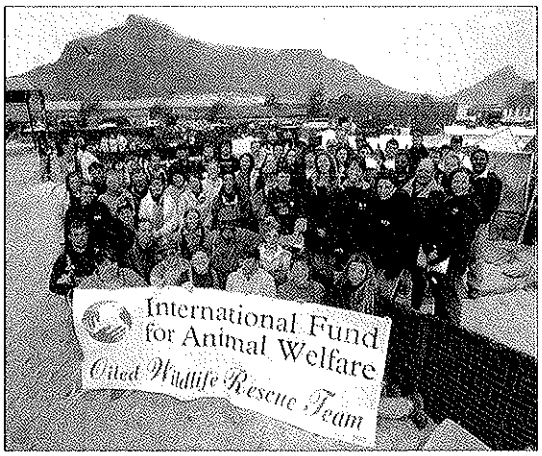
ABOUT THE JOURNAL . . .

THE JOURNAL OF WILDLIFE REHABILITATION is designed to provide useful information to wildlife rehabilitators and others involved in the care and treatment of native wild species, with the ultimate purpose of returning them to the wild. The *Journal* is published by the International Wildlife Rehabilitation Council (IWRC), which invites your comments on this issue. Through this 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: In the days following the *Treasure* oil spill in June 2000, hundreds to thousands of oiled African penguins (*Spheniscus demersus*) arrived 4–6 to a box at the two rehabilitation centers in Cape Town. BELOW: The IFAW Emergency Relief Team at the Salt River facility. [PHOTOS: Jon Hrusa]



FOR INFORMATION

International Wildlife
Rehabilitation Council (IWRC)
4437 Central Place, Suite B-4
Suisun, CA 94585-1633, USA

707/864-1761
Fax: 707/864-3106
iwrc@inreach.com
www.iwrc-online.org

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EDITORIAL

"Good Enough" Isn't Anymore!

In the field of wildlife rehabilitation, there is much talk of "professionalism."

Unfortunately, this word means something different to each person who hears it. Some fear that professionalizing wildlife rehabilitation means that home-based volunteers will be pushed out and replaced by paid staff in big centers. To others, the word is a smoke screen for a bunch of new rules and mandates that all will have to follow. Neither impression is really correct, yet the confusion seems to persist.

I suggest we consider substituting another word for professionalism. That word would be *excellence*. Instead of saying that we want to increase the professionalism in wildlife rehabilitation, we can begin thinking in terms of pursuing excellence in the care of wildlife. While this is a bit of a cliché, we can all agree that *good enough* is just not good enough anymore. We need to do better. We can never stop trying to improve.

Sadly, some wildlife rehabilitators do not seem to be open to new ideas, and appear reluctant to improve upon things that are "good enough." We must change that attitude if our community is ever to earn the respect and consideration we deserve. We must establish a culture in which continuing education is the norm and the old ways are constantly questioned and reevaluated. We must pursue excellence in all that we do.

Recently, IWRC's sister organization, the National Wildlife Rehabilitators Association (NWRA), received a grant to explore the future of wildlife rehabilitation. A special committee of federal and state regulators, wildlife veterinarians, backyard rehabilitators, and large center directors was named to consider this open-ended question. IWRC past-President Marge Gibson and I were asked to participate. As president of IWRC, I was asked to facilitate the committee meetings—a remarkable gesture on behalf of NWRA.

The committee met for three days in April of this year to examine the future of wildlife rehabilitation and to identify priority issues for further consideration. We will reconvene in mid-October. The committee recognizes that much needs to be done to improve the quality and consistency of both state (provincial) and federal regulations across the U.S. and Canada. We also agreed that we need to support the people in the wildlife rehabilitation community and help address their issues of personal growth, leadership, and overall well-being.

By far, the top priority issue for the committee is the improvement of the care given to wildlife. To do this we must improve the knowledge and skills of rehabilitators and advance our understanding of the needs of wildlife in captivity. It is in this area that collective effort can make the biggest difference for wildlife. The complete text of the committee report will be circulated shortly, but several highlights need to be considered right away:

- While IWRC, NWRA, and the various state and provincial wildlife rehabilitation organizations attract a significant percentage of those involved in wildlife care, the combined membership of these groups is still probably *a minority* of all those actively involved in some form of wildlife care across the U.S. and Canada. We need to find ways to reach and involve the full community.
- We know very little about the demographics of who are involved in wildlife care, why they enter or leave the field, their level of skills or training, how many animals receive care, or what quality of care is given. Without a more complete understanding, the organized wildlife rehabilitation community cannot meet the needs of nonmembers, nor can we influence and improve their practices.
- We need to actively promote the concept of continuously improving how we care for wildlife. We need new ways of delivering information and training. We need to pursue *excellence* in all we do, and encourage others to do the same.

The Board of Directors of IWRC is fully committed to developing programs and services for its members and others that will improve the care given to wildlife. We are actively soliciting ideas on how best to do this. One thing we know for sure, *good enough* is not good enough for IWRC.

—Ed Clark
IWRC President

On Altering MacDiet, Feeding Ducks

Is there a problem if the recipe for MacDiet (*Journal of Wildlife Rehabilitation*, 24[1]) is changed? I have received a copy of this diet with the following changes:

1) **Knox gelatine was reduced to 0.25 tsp sprinkled over the other ingredients, rather than the specified amount soaked**
2) **Vitamin B-complex was eliminated**
3) **Tums were recommended as the calcium source**
4) **Not checking 600–800 mg calcium ratio, only using higher amount**
5) **100 mg vitamin C rather than 50 mg**
6) **0.5 cup dry kitten food (Purina One or Eukanuba chicken and rice for kittens rather than Purina ProPlan feline growth**
7) **Only freeze dried bloodworms for dried insects**

I tend to stick to pretty exact amounts when doing a diet such as this and am wondering if deviation could produce undesirable effects.

—W. S., Avian rehab 20+ years IWWA,IWRC,NWRA

MacDiet has been optimized to the best of our current knowledge. Yes, there are problems with altering the diet.

1) Dry gelatin should never be fed; it may not be digested and, more importantly, it will pull water from the bird.
2) The B vitamins should be included because most of them are not stable in storage.
3) Tums as a calcium source is not optimal because it contains artificial ingredients (some of which may be carcinogenic); and sucrose, to which many or most young birds are intolerant. There are plenty of alternatives to antacids, available in any drugstore and most grocery stores. When we began working on this diet, the rehabbers who were using it in trials asked for an "easy-to-find" calcium source, and many were already using Tums. We were also concerned that other sources of calcium had been shown to be contaminated with heavy metals. After more research, we concluded that the pro's of antacids (convenience) were outweighed by the con's (as outlined here), especially since alternative products were much more easily available and of higher quality than previously. This was an opportunity for us to use new information to make changes for the better. A once "okay" addition was no longer the best choice.
4) Too much calcium can cause kidney and bone growth problems; the 800 mg may not be dangerous, but it's outside the range of known safety, unless more than 1/3 of the diet consists of live insects.
5) 100 mg of vitamin C is probably too high for some species and individuals. Even 50 mg is probably on the high end of a good range. The issue hasn't been studied in passerines to our knowledge, but it has been studied in poultry. As with many nutrients (and meds) this is *not* a case of "if a little is good, a lot is better."
6) Purina One and Eukanuba formulations are, at present, quite good. However, companies very often change their formulations, and it's important to keep reading labels.
7) The greater the variety of insects, the more likely it is that subtle nutritional requirements will be covered. Parents do not feed the same kind of insect to their babies all the time, even if it's extremely abundant. We strive to emulate nature.

When MacDiet was formulated, we purposely chose ingredients that are commonly used by rehabilitators. We analyzed, weighed, and balanced ingredients so that the resulting diet more closely resembled the natural diet of young passerines. In the article, we indicated that other combinations also work and included a number of possible ingredients, outlining pro's and con's. However, each combination needs to be carefully analyzed, weighed, and balanced.

Again, this is only one possible diet. We are presently working on other formulations that use entirely different combinations—but with each diet, we take pains to ensure that the birds' basic requirements (as they are understood today) are met.

When we formulate diets we must pay attention to a number of nutrients, such as sources and levels of protein, fat, carbohydrate, vitamins, and minerals. We look at very specific components, such as levels of amino acids, and particular kinds of lipids and carbohydrates and compare them to those found in the natural diet. We consider the digestibility of the nutrients to determine the effective caloric values, and we consider fluid requirements. With diets for hatchlings, we must consider enzymes and microbes.

There is a great deal of math and research involved. *Anyone* who is putting together a diet (or making changes to an existing diet) should be addressing all these factors and more.

We have heard several reports of people modifying the diet to make it more "convenient"; in each case, they have reduced the quality. However, there are some valid ways to make the formula more convenient. All the ingredients, except the yogurt, vitamins, and insects, can be blended and frozen, if stored in a cold freezer (0°F or lower) for less than one month. Dried insects can be ground ahead of time. Powdered egg white, made according to package directions, can be substituted for the fresh cooked version.

These alterations should not substantially alter the nutritional values or balance of the diet. Other alterations do. "Modified" MacDiet is a misnomer. After components are omitted or substituted, it is no longer MacDiet, but something else.

Thanks for your conscientiousness. We can't keep people from altering things, but we can at least tell them that a large amount of research went into the diet's formulation, and that many thousands of birds to date have done well on it. Numerous rehabbers have noted that it gives results superior to diets that are not as nutritious. Science doesn't sit still, however, and we will undoubtedly continue to make changes as new research becomes available.

—Astrid MacLeod and Janine Perlman

I was very disappointed to see the public service announcement you ran for "not feeding the ducks" (*Journal of Wildlife Rehabilitation*, 24[2]).

As a waterbird organization, we take in roughly fifty birds per year that are abandoned Easter pet ducklings and chickens, as well as some rabbits. While it is true that they do not belong out in the wild (they are domestic and cannot fly) we've never seen instances (in seventeen years) of them overpopulating. They die either from malnutrition—living on stale bread and cake from the public handouts; predators—since they are usually the white pekin variety they are more conspicuous than the darker wild ducks; injuries; illness; or starvation during winter when no one is at the lake or park to feed them.

They cannot subsist for long on wild foods because they compete for food with wild ducks. What happens come winter when natural food is nonexistent? The wild counterparts migrate or fly off to eat the spent corn or wheat in farmland; the domestic birds cannot.

I think that a more appropriate PSA would be on not purchasing or obtaining or hatching in classrooms baby ducks and geese so that they never end up in the wild in the first place.

It is cruel not to feed the domestic ducks. They did not fly there; they were put there. And while you cannot prevent the wildfowl from staying for a free lunch, we must not take it out on the poor domestic ducks.

Our organization accepts domestic throwaways, so maybe we are more in tune to the problem and have compassion for these birds, too.

—Donna L. Powers
Director, Water N' Webs
Waterbird Rehabilitation Center, Inc.
Northford, Connecticut

This letter is very welcome as it raises several important issues. We thank the writer for sharing her thoughts and encourage others to also offer their critical, constructive feedback on the topics presented in the journal.

One of the key issues this letter raises is regional differences in experience. Although the problems of domestic overpopulation on public waterways may not be serious in Connecticut, in many areas of the United States and elsewhere they are. In Texas, for instance, it is not unusual to find more than fifty domestic ducks on a single small Houston business-park pond. If not for the snapping turtles and former pet red-eared sliders, the ducks would probably be stopping traffic on I-10! In Alburquerque, large numbers of released former pets are rare. On the other hand, the many artificial lakes around Phoenix, Arizona—also a desert—are a home for these abandoned domestic creatures. There is no one single reality.

It may be that most of the ducks the writer sees as having problems are abandoned "Easter Duckies"; however, there are a number of domestic ducks that can and do fly, and compete successfully with wild ducks for wild food. Mallards are one such species. In New Mexico, a duck that weighs significantly more than 1 kg (2 lbs) is judged, by rule of thumb, to be of domestic origin and placed in a farmyard environment rather than released to the wild.

Not only do domestics out-compete wild species, they cross-breed with the wild ones, and male pekin and muscovy (and their crossbred offspring) regularly "gang rape" female wild ducks, particularly mallards. In some parts of the U.S., rehabilitators frequently have to care for female mallards that had been injured or practically drowned by male domestics.

Nor are all domestics on ponds former Easter pets. Often neighborhoods decide they *want* ducks on their local pond—at least until overfeeding results in overpopulation and its accompanying noise, smell, mess, etc. Then they call rehab centers and want to know how to reduce the population...but not feeding is cruel, and so is removing eggs or addling them....

Understanding carrying capacity and its relationship to the food supply is very important when deciding whether or not to feed. Feeding *is* cruel, in the long term, and eliminating extra food (and in some cases, removing or addling eggs) is the only way to prevent overpopulation. You will never, ever eliminate this problem by providing more food.

Domestic waterfowl clearly need the help of people to survive. It is thoughtless and cruel of people to abandon former domestics to fend for themselves in the wild. If the Waterbird Rehabilitation Center rescues these birds and places them in good homes, benefitting both the wild and the feral populations, it should be commended for this. In this way, the feral animals can be brought back into care and the wild animals have free access to the wild foods, as it should be.

Other organizations have had similar success. For the past twelve years, the East Valley Wildlife Rehabilitation League in Chandler, Arizona, has successfully placed domestic ducks and geese in adoptive homes where people can enjoy them as pets. Prospective adopters are screened, and homes that meet the league's criteria are then checked out to make sure they will provide secure fencing, shade and shelter, water, food, and protection from predators. One reason for this program is that area lakes are already overcrowded. Lakes are often culled (ducks are removed/destroyed) when the duck population becomes a problem.

The journal's Ditto PSAs are intended for those who may find them useful locally. They are not a statement of an IWRC position on any particular issue. The writer is correct in noting that many rehabilitation centers could make good use of a Ditto that discourages the hatching and dying of Easter ducks. The winter 2001 and spring 2002 issues of the journal will include educational PSAs developed by the East Valley Wildlife Waterfowl Adoption Program. The first discourages people from purchasing live chicks, ducklings, and rabbits as Easter gifts. The second discourages those who did purchase a duck to *not* dump their "pet" at the local park lake to "give it its freedom."

—The Editors

The Editors encourage readers to respond to the articles, columns, and other items featured in the Journal of Wildlife Rehabilitation. *Please direct general questions and comments to the Editor at runmuki@aol.com (USPS address on the journal's inside back cover). To respond to a specific article or column, please contact the author directly. Those letters that seem most beneficial to the greatest number of readers will be included in our new Letters pages. (NOTE: Letters may be edited for clarity and length.)*

JWR

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

by Edythe Butler

ABSTRACT: This is Part II 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 II reports on this pup's care and development from 2 to 8 weeks of age. Her growth and forearm measurement in comparison to those of wild mother-reared pups and captive mother-reared pups is charted. Once she starts to fly at 4 weeks of age she is housed in a 3.7 x 1.4 x 2.4 m (LxWxH; 12 x 4.5 x 8 ft) flight tent, where she is weaned from milk formula to mealworms and gradually learns to self-feed from a dish of mealworms left in the tent overnight. Three other big brown bats—a mother bat and her captive-reared twin youngsters—are introduced to the flight tent to condition them for a planned soft release at Peep's natal colony, and to provide Peep with conspecific company.

KEY WORDS: wildlife rehabilitation, Microchiroptera, big brown bat, *Eptesicus fuscus*, bat pup, growth and development, forearm measurement, weaning, flight training, conspecific, observational learning

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.

J. Wildlife Rehab. 24(3): 5–12

Introduction

This is Part II 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 covers 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—are introduced to the flight tent to condition them for release and to provide Peep with conspecific company. Part III will follow Peep and her tent mates for the last 3.5 weeks of flight training. The addition of a hackbox in the flight tent and its use in the "soft" release back to Peep's natal maternity colony roost will be described, and postrelease tracking or marking options will be discussed. Release strategies used for captive-reared insectivorous bat pups in North America will also be reviewed, and one divided hackbox technique used in Europe will be described. No postrelease data was collected that documents 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, introduced to three other captive big brown bats, and later soft released back at her natal maternity colony roost under the farmhouse eaves.

Methods

Raising Miss Peep: Care and Development

2 to 4 weeks of Age (19 June–3 July 1999)

At 2 weeks of age Peep was lightly furred, but still housed in a small plastic mesh-topped cage set in an incubator at 32°C (90°F). Big brown bats housed in slick plastic containers sustain injury when they try to climb around, so it is important that surfaces are covered if such caging is used. Peep's cage was completely lined with layers of cotton cloth and padded on the bottom, making it easy for her to climb and maneuver around without danger of injury.

Peep was weaned onto mealworm viscera squished out into her mouth from decapitated mealworms (Barnard 1991). At 18 days of age this pup began to eat the exoskeletons, an indication that her permanent teeth may have erupted about that time. She weighed 14 g by then, almost four times her birth weight (Figure 2). Shedding of the milk teeth and eruption of permanent dentition coincides with flight and the appearance of insects in the diet (Fenton 1983). Beasley-Brunotte (1999, pers. comm.) noticed permanent teeth erupting in an orphaned big brown bat pup in her care at about 17 days of age. Sakolsky (1999, pers. comm.) noted "adult looking" facial characteristics at day 22 in a set of captive-born, mother-reared twins, and attributed it to their perhaps having permanent teeth by then. Walker (1999, pers. comm.) noted permanent teeth in a captive-born, mother-reared pup at 19 days of age when he ate his first whole mealworm.

TABLE 1. "MISS PEEP," A HAND-RAISED BIG BROWN BAT PUP (*EPTESICUS FUSCUS*) CARE SUMMARY: 2 TO 4 WEEKS OF AGE, 19 JUNE–3 JULY 1999

Age (weeks)	Age (days)	Weight (grams)	Comment	Feedings
2	14	10.5	Pup is fed 4x a day. Although she is lightly furred, she is still housed in an incubator set at 32°C (90°F). Mealworm viscera are introduced at 3 of the 4 feeds, starting with 2 mealworms and working up to 8.	6 & 12 A.M. and 6 & 10 P.M.: formula **(A)** + mealworm viscera **(B)**
	18	13.1	Pup is fed 3x a day. Decapitated mealworms are introduced, starting with 1 and working up to 10. Vitaminized water is now offered at each feed, along with formula.	7 A.M. and 1 & 8 P.M.: formula + decapitated mealworms **(C)** + vitaminized water **(D)**
3	21	15.0	Pup is starting to stretch and exercise her wings at each feed.	7 A.M. and 1 & 8 P.M.: 10 decapitated mealworms + formula + water
	24	16.8	Pup is fed 2x a day.	7 A.M. and 8 P.M.: 15 decapitated mealworms + formula + water
4	28	18.6	Whole live mealworms introduced, hand-fed while pup is held over a dish. First flights off caregiver's hand.	7 A.M. and 8 P.M.: 5 decapitated mealworms + 2 live mealworms + water + formula

A = Mother's Helper™ puppy powder, with 1 drop Avitron® + 2 drops Avimin® (Lambert Kay) added to every 35 ml of prepared formula (Lollar and French 1988)

B = Mealworm viscera are squished from decapitated mealworms into the pup's mouth (Barnard 1991)

C = Decapitated mealworms. Pup starts to eat the exoskeletons at 18 days of age.

D = Vitaminized water = 1 drop Avitron® + 2 drops Avimin® added to every 35 ml of water (Barnard 1991)

Raising Miss Peep: Care and Development
4 to 8 Weeks of Age (3–31 July 1999)

Peep ate her first whole live mealworms and started to fly at 4 weeks of age, weighing 18.6 g (Table 1). At 4 weeks of age Peep was still being offered formula two times a day and was hand-fed mealworms each time, while being held over the food dish. Gradually, over the next two weeks (by 6 weeks of age) she mastered the task of catching them for herself. Self-weaning from formula, also a gradual process, was accomplished by 8 weeks of age (Table 2, Appendix A).

Not surprisingly, due to the strenuous demands of flight, there tends to be some weight loss in pups between time of fledging at 3–4 weeks of age, and weaning at 5–8 weeks (Davis 1967 and 1968 [cited in Tuttle and Stevenson 1982]) (Figure 3). Fat is metabolized during the early flight period (Kunz 1985), and time of weaning can vary considerably, being partly determined by the state of development of the young bats (Tuttle and Stevenson 1982). A study in Massachusetts reports big brown bat pups in the wild weaned from 32–40 days after birth (Burnett and Kunz 1982).

Peep made her first practice flights in a bedroom at 4 weeks of age, and a few days later (on 8 July) she was placed in a flight tent sewn from cotton sheets. The tent measured 3.7 x 1.4 x 2.4 m (LxWxH; 12 x 4.5 x 8 ft) and was hung (staple-gunned to a light wood frame) in a spare bedroom over an open screened window in an attempt to mimic an attic-style roost. It allowed Peep to experience the 24-hour temperature fluctuations, to hear the outside sounds at night, and to have some access to sunlight if she wanted it. Although sunlight may not be necessary for big brown bat pups, the author felt

TABLE 2. "MISS PEEP," A HAND-RAISED BIG BROWN BAT PUP (*EPTESICUS FUSCUS*) CARE SUMMARY: 4 TO 8 WEEKS OF AGE, 3–31 JULY 1999

Age (weeks)	Age (days)	Weight (grams)	Comment	Feedings
4	28	18.6	Pup is hand-fed whole live mealworms while held over a glass, deep-dish pie plate, and is urged to catch them herself. Before the 8 P.M. feed she is given practice flights off the caregiver's hand.	7 A.M. and 8 P.M.: 5 decapitated mealworms + 2 live mealworms + water + formula
	33	17.8	Pup is introduced into a 3.7 x 1.4 x 2.4 m (LxWxH; 12 x 4.5 x 8 ft) flight tent sewn from sheets, stapled to wood trim, and hung over an open screened window in a secure indoor room. She is soon active flying overnight.	7 A.M. and 8 P.M.: 9 live mealworms + water + formula
5	35	17.5	Pup is placed in the dish of mealworms, which are herded toward her face to help her catch them. Vitaminized water is provided in a hamster waterbottle and in a very shallow (0.6 cm; 0.25 in) dish.	7 A.M. and 8 P.M.: 9 live mealworms + water + formula
	37	17.4	Introduction of a mother bat and her two 10-week-old youngsters into the tent with Peep. All are fed mealworms and offered water from a syringe.	7 A.M. and 8 P.M.: 12 live mealworms + water + formula
	38	16.6	Bats are placed one at a time in the mealworm dish. Peep and the 2 youngsters gradually learn to self-feed over the next 4 days, but the mother bat continues to need caregiver help. Mealworms left out in the dish overnight are not yet eaten.	7 A.M. and 8 P.M.: 10 mealworms in A.M. + 6 mealworms in P.M. + water + formula
6	42	18.1	Peep and the 2 youngsters are placed 30–38 cm (12–15 in) above the mealworm dish and encouraged to flutter down to eat, while the caregiver draws attention to the mealworms. Mealworms left out overnight are not yet eaten.	7 A.M. and 8 P.M.: 15 mealworms in A.M. + 10 mealworms in P.M. + water + formula
	43	18.0	The 3 pups learn to flutter into the dish to eat. Mother bat continues to need help and is placed in the dish to eat. Mealworms are left out overnight, and for the first time, 28 are eaten.	7 A.M. and 8 P.M.: 15 mealworms in A.M. + a share of the 28 left overnight + formula
7	49	19.6	Peep is offered formula until she self-weans at 8 weeks of age. Mealworms are left out each night.	8 P.M.–7 A.M.: a share of 50 mealworms
8	56	20.2	Peep and the 2 youngsters self-feed from the dish of mealworms. The dish is moved around to different locations on the floor and on a low, cloth-draped chair in the tent.	8 P.M.–7 A.M.: a share of 50 mealworms

allowing the pup the option could not hurt. Within a few days the pup was flying well and was very active every night. Obviously, this tent was flimsy and only suitable for use in a secure indoor room.

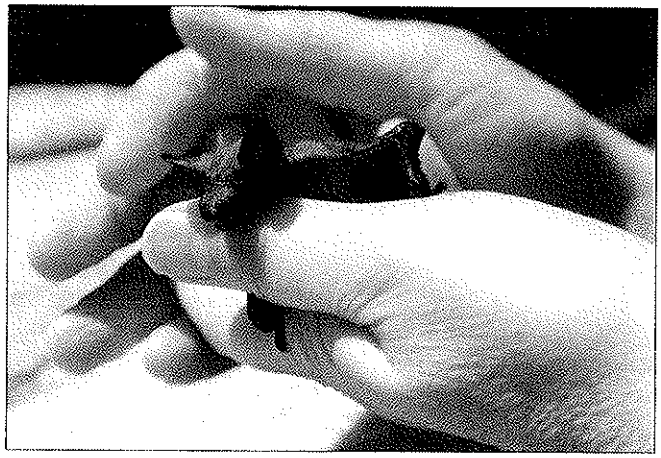
Early in July, Peep's maternity colony was identified under the eaves of an Ottawa farmhouse. The author watched at dusk as about 20 individual bats exited and foraged around the farmhouse. This offered the best scenario for release: once flying well and self-feeding from a dish, Peep could be soft released back to her natal colony.

At this time, a female big brown bat and her twin youngsters were introduced into the flight tent, to give Peep conspecific company and to add them to the release effort. The female bat had been found inside a building in Ottawa in February, with no apparent injuries but unable to fly. She was admitted to rehabilitator Selena Walker's care weighing about 17 g. Since she was thus aroused from hibernation and kept warm and well fed, her pups were born in late April about 5 weeks ahead of the wild schedule. (Peep was born 5 June.) They were raised by their captive mother, housed in a small plastic mesh-topped cage (again, with all slick surfaces completely lined with cotton cloth) set in an incubator until they were 4 weeks old. They were then free to learn to fly in an indoor flight room (from 4 to 10 weeks of age.) They were weaned at the time of transfer to the tent on 12 July. Measurements for the three pups are recorded in Table 3.

These two captive-born, mother-reared youngsters were 5 weeks older than Peep but smaller than her, and plumper. They appeared healthy and active and quickly learned to self-feed from the bowl of mealworms placed on the floor or on low cloth-draped chairs in the tent.

Geographical variation, environmental influences, and captivity vs. wild rearing all influence rate of growth in bat pups (Anthony 1988). Kunz reported in 1985 that postnatal growth of bats in captivity was seldom comparable to data from field studies, with young captive-reared bats often weighing more than bats of a similar age in the field, and many showing signs of stunted bone growth. Although captive-reared insectivorous pups still often weigh more than those of comparable age in the wild, many bat rehabilitators now raise pups exhibiting normal bone growth (French 2001, pers. comm.). Peep did not show signs of stunted bone growth, but she and two sets of captive, mother-reared twins at a wildlife rehabilitation facility in Pennsylvania did weigh more than weights reported for wild youngsters (Sakolsky 1999, pers. comm.).

Peep's cagemates, the captive mother-reared twins, although in the same weight range as wild youngsters, were in



PHOTOS: SEAN BUTLER

FIGURE 1. Peep at 2 weeks of age. She is starting to eat mealworm viscera squashed out into her mouth from decapitated mealworms.

FIGURE 2. Peep at 19 days of age, 24 June 1999. She now weighs 14 g, almost four times her birth weight. Note the adult-looking facial features that indicate permanent dentition has likely erupted.

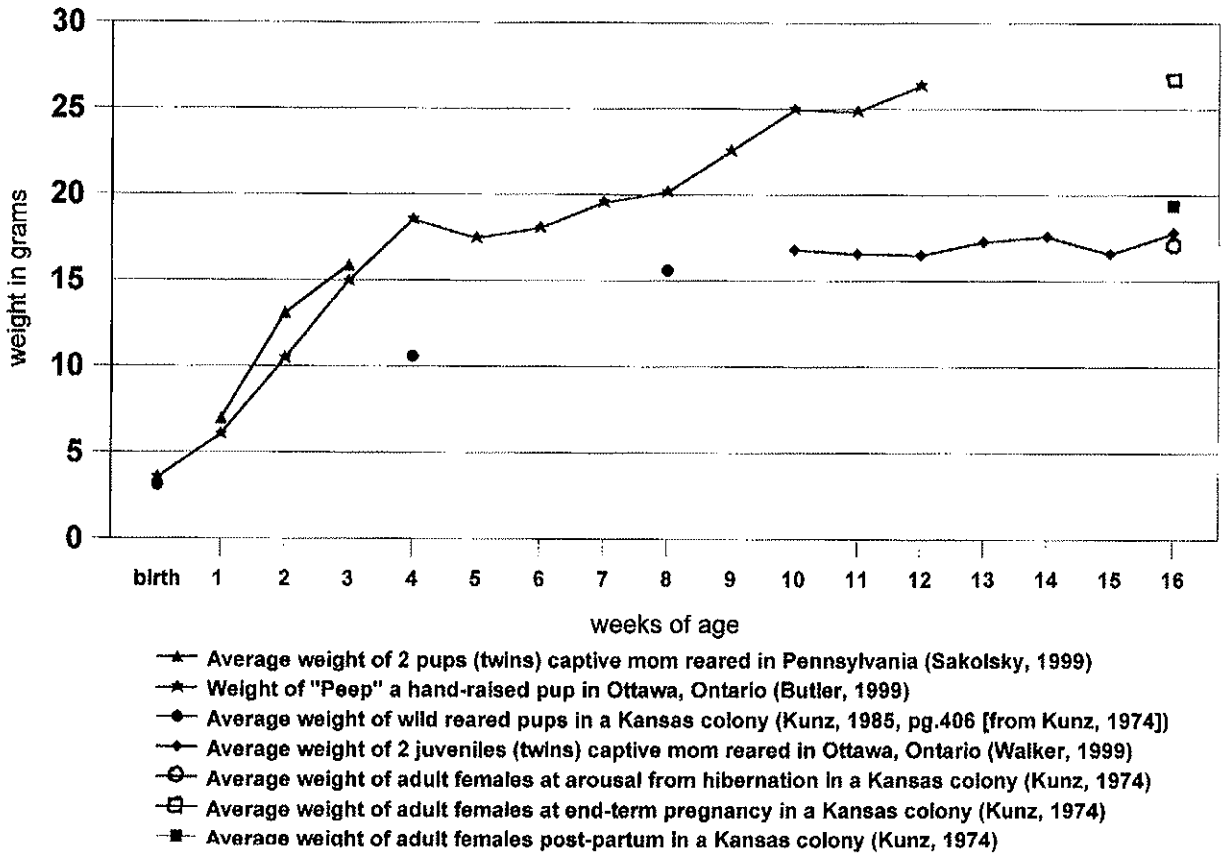
PLEASE NOTE: ***Peep was admitted into care the day she was born, and her mother tested negative for rabies. The author did not wear gloves to handle this animal. Whether or not the animal's rabies status is known, this should not be taken as a recommendation to others.***

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 [3 in]	38 mm [1.5 in])
female twin	10 weeks	17.7 g	(*no more than 57 mm [3 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.*

FIGURE 3. GROWTH CURVE FOR BIG BROWN BAT PUPS (*EPTESICUS FUSCUS*)



fact heavier relative to their size, since they had shorter forearm and body length compared to wild juveniles. Since big brown bat pups reach 75% of adult body weight and more than 95% of forearm growth solely on their mother's milk before first flight at about 4 weeks of age (Burnett and Kunz 1982; Kunz and Anthony 1982), these twin youngsters' prenatal and/or early postnatal development may not have been optimal, perhaps the result of whatever physical stresses brought their mother into care. They were significantly undersized for their species (Figures 3 and 4).

Observational Learning

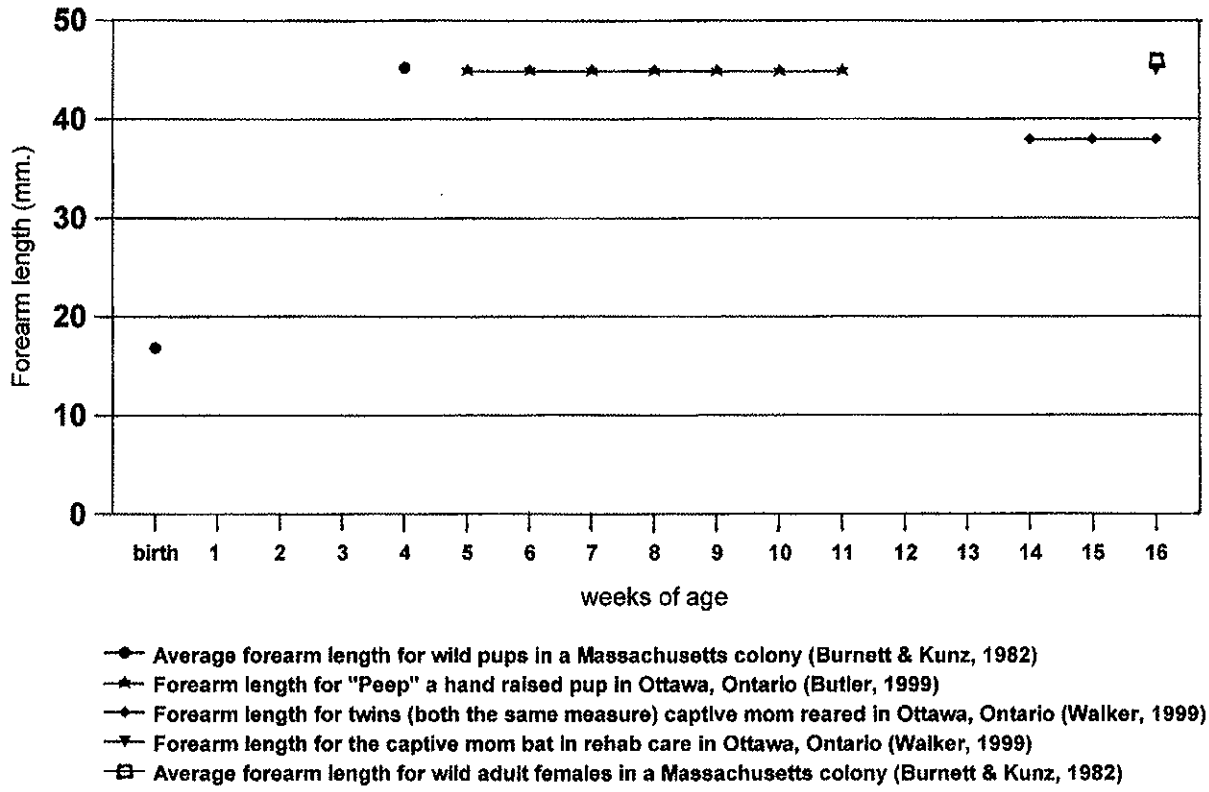
Fenton (1985) considers big brown bats and little brown bats (*Myotis lucifugus*) to be relatively asocial albeit gregarious, but states that observational learning is not limited to the more social species.

There is much evidence that big brown bats do learn from other bats. Big brown bats follow the feeding calls of other big brown bats, and of little brown bats and vice versa (Barclay 1982 [cited in Fenton 1985]). Gaudet (1982 [cited in Fenton 1985]) trained individual big brown bats, little brown bats, and pallid bats (*Antrozous pallidus*) on a food location task. She then allowed naive conspecifics (recently captured from the wild) to observe the trained bats as they fed. The observer bats learned the new feeding behavior very quickly, in a couple of days, and there was no significant difference in learning time between observers from the three different species. Wilkinson (1992) studied information transfer in evening bats (*Nycticeius humeralis*) in Missouri. Females arrived at the maternity roosts in April and gave birth in early June. Foraging success improved when unsuccessful bats (both adult and juvenile) followed previously successful foragers. One interesting observation involved pregnant bats held captive from two separate maternity colonies, the Smith colony and the Thompson colony. After a week in captivity, several escaped. All the Smith bats were recaptured at the Smith colony, as well as one of the two Thompson bats. This bat had escaped in an unfamiliar area and had apparently followed the Smith bats to their colony. During one-night exclusion experiments in mid-July, bats vocalized and wheeled in front of their blocked roost site, and at least 40% (including youngsters flying only about 2 weeks at that time) regrouped at a single alternate roost site.

Flight Tent Discussion

A large, properly constructed flight cage is the ideal for bat rehabilitators to aim to provide (Lollar and French 1998). The 3.7 x 1.4 x 2.4 m (LxWxH; 12 x 4.5 x 8 ft) flight tent

FIGURE 4. FOREARM GROWTH FOR BIG BROWN BAT PUPS (*EPTESICUS FUSCUS*)



that the author improvised out of cotton sheets for Peep and her cagemates is not considered adequate housing if one is attempting to allow big brown bat pups the chance to achieve perfect flight skills or to gain much practice in catching insects on the wing. Big brown bats can fly in an area the size of this home-made tent, but they are not likely to practice the kind of aerial dynamics needed to catch insects on the wing. French recommends that prior to release, big brown bat youngsters should be housed in a large flight area—7.3 m (24 ft) long x 7.3 m (24 ft) wide—with flying insects made available, allowing the young bats' ability to forage on the wing to be ascertained. If space is limited, this caging might be reduced to 6.7 m (22 ft) long x 5.5 m (18 ft) wide, as a very minimum (French 2001, pers. comm.).

However, in the situation reported in this paper, the author's goal was to give the bat pups the chance to exercise, gain some flying stamina, learn to self-feed from a familiar dish of mealworms in a familiar hackbox, and (in Peep's case) to recognize and bond with conspecifics, in preparation for a soft release back to Peep's natal colony at an Ontario farmhouse. A postrelease transition period—during which food and water would be provided in the familiar hackbox and feeding dish at the release site—was planned, such that the young bats would have time before they had to be entirely self-sufficient to perfect their flight and to observe and learn from the colony bats in the wild as they foraged every night around the farmhouse and over a small river.

The sheets used to sew the flight tent were old, well laundered, and even patched in many places, providing a rough enough surface to allow the bats to land, find footing and easily climb around on the inside of the tent. However, it was obviously a flimsy cage that could only be used in a secure room, and a bat could chew out if motivated to do so. Luckily, these four never tried. A secure indoor room could be "bat-proofed" and used instead, but the advantage of the tent, particularly for a home-based rehabilitator who rarely needs a large flight area for bats, was that the bedroom furniture could remain in the room, and the bat feces was confined to the tent.

In future, if using this tent again, the author would enlarge it as much as possible and add a roosting box—to be used later as the release hackbox—where the bats could be safely and securely confined for the daylight hours. A third refinement would be to piece the tent together from sheets (or a strong rough-textured fabric) with Velcro or zippers sewn along the edges, so it could be pulled apart for laundering. (This one was washed by hand in a bathtub.) Windows could be fashioned by sewing on screening or mesh so the bats could be viewed from outside the tent, making monitoring their flight and self-feeding abilities easier. If a 6.4 mm (0.25 in) mesh window was added to the tent and aligned with an open unscreened window in the room where it was hung, flying insects might be attracted into the tent as well. However, even with refinements it is unlikely such an indoor tent would allow

TABLE 4. PRODUCT SOURCES AND INTERNET SITES

Avitron® and Avimin®	Avian vitamin/ mineral supplements from Lambert Kay, a division of Carter-Wallace Inc. (Cranbury, New Jersey) Website: www.lambertkay.com; E-mail: info@lambertkay.com; Tel: 609-655-6293. Available at pet supply stores.
Hills Science Diet	Use feline kibble crushed as part of the mealworm substrate. Available at pet supply stores, or on line at the website: www.hillspet.com ; Tel (U.S.): 1/800/445-5777; Tel (Canada): 1/800/668-4626.
Mealworm Suppliers	Listing is available online at the IWRC website: www.iwrc-online.org/rehab/mealworms.htm or at: www.deadanimal.com/crix.html. One supplier is Grubco, Hamilton, Ohio; Tel: 1/800/222-3563.
Mother's Helper™	Puppy milk replacer from Lambert Kay, a division of Carter-Wallace Inc., (Cranbury, New Jersey). Website: www.lambertkay.com; E-mail: info@lambertkay.com Tel: 609/655-6293. Available at pet supply 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.
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.
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.

captive-reared big brown bat youngsters the opportunity to become perfect flyers or entirely self-sufficient at foraging on the wing. Thus a soft release set-up with food and water provided for a time postrelease is still an integral part of such a rehabilitation effort.

Acknowledgments

Heartfelt thanks to the many wildlife rehabilitators who generously provided advice and moral support during the raising of Miss Peep, including Rebecca Beasley-Brunotte, Lois Sakolsky, and Selena Walker for sharing their unpublished big brown bat pup rehabilitation notes, and most especially to Selena Walker, who delivered this newborn bat into my care, added the mother bat and her twin youngsters to supply conspecific company, and collaborated with me in the rehabilitation and release effort.

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APPENDIX 1. MEALWORMS

A. Mealworm Nutrition

Mealworms used to feed wildlife often arrive wrapped in newspaper. Place them in a nutritious substrate for a few days before feeding them to the bats. There are several published recipes for mixing a nutritious substrate (Barnard 1991, 44; Lollar and French 1998, 44). The author fed mealworms the following recipe (measurements are approximate):

710 ml (3 cups) raw noninstant rolled oats

118 ml (0.5 cup) wheat germ

118 ml (0.5 cup) oat bran

118 ml (0.5 cup) crushed Science Diet feline kibble (put in a plastic bag and hit with a hammer)

59 ml (0.25 cup) dry powdered milk formula or skim milk powder

30 ml (2 tablespoons) debittered brewer's yeast or nutritional yeast

after adding the mealworms to the substrate, sliced vegetables or fruit was placed on top

a light sprinkling of vitaminized water was then added over the fruit/vegetable slices
(vitaminized water = 1 drop Avitron® + 2 drops of Avimin® to each 35 ml of water)

Each morning a day's supply of mealworms was counted out from the substrate, placed in a clean container with some fresh substrate and fresh fruit and/or vegetable slices very lightly sprinkled with vitaminized water, and set in a warm place to let them feed. Soft sweet fruits such as cantaloupe disappeared fastest; the author also used many other fruits and vegetables, including apple, banana, carrot, broccoli, zucchini, and spinach.

B. Introducing Mealworms to Bat Pups

When Peep was 2 weeks old, the author chopped the heads off mealworms with manicure scissors and squished the viscera out onto the bat pup's lips. Peep readily licked it up. At 18 days of age she was able to eat the decapitated mealworm, including the exoskeleton. She graduated to whole live mealworms by 4 weeks of age.

C. Teaching Pups to Self-Feed on Mealworms

Teaching Peep to self-feed from a bowl of mealworms required time and patience. She was held over the same dish when hand-fed. This was a large, heavy glass, deep-dish pie pan that the mealworms could not climb out of. As soon as Peep was eating whole live mealworms, the author started to place her in the dish, and herded a pile of mealworms toward her face. At first the pup made valiant but unsuccessful attempts to scoop them into her mouth using the "bat hulk" posture, extending wing and tail membranes. The author helped as much as necessary, holding the mealworms down and hand-feeding them to her, but always made Peep try to catch them herself. Once Peep was housed in a flight tent starting at 33 days of age, the dish of mealworms was left out overnight for her. The author still helped her feed morning and evening, and it wasn't until Peep was 6 weeks old that she learned to fly down at night to eat on her own from the dish.

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To Contact the Author
Edythe Butler
211 Daniel Avenue
Ottowa, Ontario
K1Y 0E1
Canada
Tel: 613/722-5281
E-mail: mcbutler@chat.carleton.ca

Case Study: Crop Impaction and Fractured Tibiotarsus in a Ruby-Throated Hummingbird *(Archilochus colubris)*

by Lauren V. Powers and Janine Perlman

Problem

One of the authors (J. P.) was called early in the week by a member of the public who shall be given the pseudonym of "Gail" for the purposes of this discussion. Gail reported that a hummingbird had been trapped in her garage over the weekend, 3 days prior. In an attempt to remove the bird, she battered and injured it, until it was unable to fly. Not expecting the bird to live through the night, she took the bird into the house, put it in a box, and placed it in the dark. However, the next morning the bird was still alive.

Gail was a health professional at a local hospital, and she worked long days. For the next 3 days, she kept the bird in the dark 24 hours a day and exposed it to light only long enough to offer it sugar water (approximately 20% sugar) twice a day, before she went to work and after she arrived home. She was unable to find any helpful information until she contacted this rehabilitator.

Gail was unable to bring the bird for care for an additional 4 days. She was instructed to put the bird on a 12 hour:12 hour light:dark cycle and to leave food for the bird in a syringe where, the bird could reach it without having to move. She was told to add protein to the sugar water. It was suggested that she attempt to obtain Vital HN™ (Elliston and Gillett 1994) through her hospital's kitchen.

The kitchen did not have Vital HN™ but it had Casec™, a powder made almost exclusively of calcium caseinate (a milk protein). Gail was told to add this to sugar water (25% sucrose) at 20 mg/ml, which would give the bird about twice the minimum daily requirement for protein if it drank 10 cc/day. However, it appeared that the bird drank little during the day. Upon close inspection of the bird's holding cage at presentation, it was noted that the bird did not, in fact, have access to the food since it was well out of reach.

Initial Presentation: The hummingbird was resting on absorbent toweling placed on the cage bottom. It was alert but unable to stand and did not attempt to fly.

Initial Physical Examination: The hummingbird weighed approximately 5 g. It could not put weight on its right leg. It was very thin, as determined by a prominent keel bone. Although the plumage was unkempt, there did not appear to be substantial damage to the feathers.

The bird had a round, firm, tan mass along the left thoracic inlet in the area of the crop, approximately 0.9 cm in diameter. A fine needle aspirate of the mass was obtained for diagnostic cytology. A modified Wright's-Giemsa stain was used for evaluation. Proteinaceous debris and scattered epithelial cells without inflammatory or neoplastic changes suggested that the mass was comprised of impacted ingesta. It was clear that the impaction was not complete, since the bird was still producing urine and a small amount of feces. The midsummer weight range for female ruby-throated hummingbirds is 2.6–4.2 g (Robinson et al. 1996). It is reasonable to assume that nearly half of the bird's weight at presentation was composed of the impaction, given the expected weight and this bird's emaciated condition. Because the accretion was not removed all at once, but over 2 days, during which the bird gained weight (as judged by palpation), and because of the bird's extreme thinness, the authors were unable to ascertain its true, or exact, weight at the time of intake.

A closed, midshaft, complete fracture of the right tibiotarsus was detected upon palpation of the limb. There was moderate soft tissue swelling and mild bruising associated with the fracture. Blood supply and neurologic function to the limb appeared intact.

ABSTRACT: An adult female ruby-throated hummingbird (*Archilochus colubris*) was presented 1 week following blunt injuries during capture, with secondary starvation, inadequate diet, and extremely poor nursing care. The bird was presented with a fractured right tibiotarsus and had a 1 cm crop impaction of calcium caseinate, which was part of the diet provided by the finder. The impaction was partially debulked by curettage, then treated with oral delivery of a crude extract of pancreatic enzymes. The crop impaction was nearly fully resolved within 48 hours. A tape splint was applied to the fracture so that the bird could perch. The bird began regaining strength immediately, and within days was flying and eating normally in a large sunroom. It was released in time for the fall migration.

KEY WORDS: hummingbird, *Archilochus colubris*, crop impaction, soluble dietary protein, therapeutic use of digestive enzymes, orthopedic splinting

LAUREN V. POWERS, DVM, ABVP, (avian) is a board-certified avian veterinarian in private practice at Timberlyne Animal Clinic, Chapel Hill, North Carolina, USA.

JANINE PERLMAN, PHD, has a doctorate in biology and is an avian rehabilitator specializing in hummingbirds and passerines in Little Rock, Arkansas, USA.

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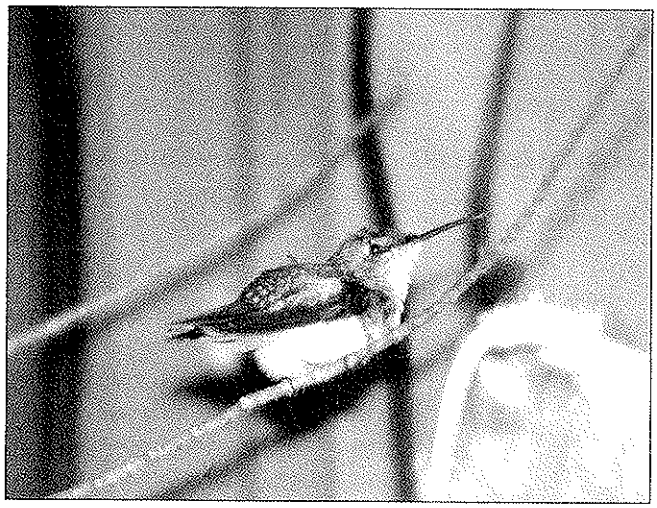

The bird was able to perch nearly normally with its leg splinted.

Methods

Initial Veterinary Treatment: The bird was given 0.30 ml lactated Ringer's solution subcutaneously. A small stainless steel bone curette was passed through the oral cavity while gripping the tip of the mandible to extend the neck. Small scoops of the caseinate were removed by this method during about seven to 10 attempts. Between every two to three attempts, the bird was offered a liquid diet by syringe and given a chance to regain strength. However, this method was stressful and time consuming. It was clear that the entire mass could not be debulked without risking the life of the bird. Given the stressful nature of the initial treatment, stabilization of the fracture was postponed until the impaction was resolved and the bird regained strength. In the veterinarian's opinion, the impaction was more of a life-threatening problem than the fracture.

A decision was made to attempt to dissolve the protein impaction enzymatically with a dried porcine pancreas concentrate (Pancrezyme®). Each 2.8 g of this dried concentrate contains 71,400 USP units of lipase, 388,000 USP units of protease, and 460,000 USP units of amylase. A small pinch of the extract was combined with about 0.05 cc of sugar water and given directly by mouth every 2–4 hours.

Initial Rehabilitation: The bird was kept on soft cotton toweling, in a cage with very little vertical space. It was immediately started on a more nutritious diet. A solution containing Vital HN™ (Elliston and Gillett 1994) was offered, which the bird rejected. Nektar Plus™ was also rejected. A 25% sugar water solution was then mixed with approximately 5% Tonic-I™ and a small amount of poultry hydrolysate (obtained by personal communication with a byproducts spray-dry company) to provide soluble protein, along with vitamin-B complex until the solution was lemon-yellow, and ascorbate (a few small grains of a ground tablet per 10 cc of food). The bird readily accepted this food.

The hummingbird rapidly regained strength and interest in its environment. Despite a reduced intake of food, fecal output was substantial, suggesting rapid digestion of the protein impaction. Within 24 hours the bird was attempting to fly in its small enclosure. One day after initial presentation it was presented once more for veterinary assessment and care.

Medical Progress: The hummingbird now weighed approximately 3 g. The size of the crop impaction was reduced by at least 75%. The bird was stronger and more alert and resisted restraint more than previously. The soft tissue swelling around the fractured right tibiotarsus was reduced, but a fibrous callous had not yet formed. It was determined that the bird was now strong enough to withstand splinting of the fracture.

The right leg was prepared for a tape splint by plucking all feathers from the tibiotarsal area, both laterally and medially. Herbst's corpuscles at the base of feather follicles are highly innervated and respond to even very small changes in feather position. Gentle and Hunter (1990) demonstrated EEG activity upon feather plucking that indicated significant pain. Cooper and Harrison (1994, 616–17) note that birds react to feather plucking even when they are anesthetized sufficiently to perform surgery. In general, therefore, plucking is best done under anesthesia. However, given the extremely small body size of a hummingbird, rapid loss of body heat is very likely during sedation despite the use of external heat sources. This hummingbird was not anesthetized for this procedure.

Approximately three strips of 1/4 inch (3 mm) cloth bandage tape were applied to both the medial and lateral aspect of the fractured tibiotarsus. Principles of fracture immobilization require that the joint above and below the fracture be immobilized for ideal repair to reduce rotational forces on the fracture and to prevent a fulcrum-like effect of the bandage on the fracture. An attempt was made to extend the tape splint as close as possible to the knee and heel (intertarsal joint), although immobilization of the knee cannot be achieved with this type of splint since that joint is fully surrounded by the inguinal skin web. The heel was immobilized by applying a smaller (1.5 mm [1/8 inch]) strip of tape as a "stirrup" across the tarsometatarsus to the cranial portion of the tape splint. The bird was immediately able to bear weight and perch with the fractured leg.

Dietary supplementation of Pancrezyme® was discontinued within several hours of the veterinary progress visit.

Results

The bird quickly learned to fly and perch using the splinted leg. It leaned to the unaffected side, but would flex the toes of the fractured limb around a perch normally. Within two days of initial treatment, it was transferred to a small flight cage for exercise. Two days later the bird was allowed to fly free in a sunroom to regain strength. The bird remained very active and caught hundreds of fruit flies (*Drosophila*) on the wing daily, and fed on nectar by hovering. Estimation of body condition by palpation of the pectoral musculature was good after several weeks. After the splint was removed, the bird regained its ability to perch normally on the right leg, although it did not regain ability retract it against the body in normal position while flying.

Veterinary Progress: The crop impaction was fully resolved within a few days of initial presentation. The splint was reevaluated weekly until week 5. The splint was left on for a period that is standard in practice with larger companion

birds. However, some rehabilitators and practitioners have had success using wraps or splints on hummingbirds, particularly young and growing birds, for much shorter times. Tape splints on larger birds, particularly those capable of chewing on the tape, are typically changed weekly. However, the small body size of the bird, cleanliness of its enclosure, and lack of chewing allowed the original splint to remain until week 5.

The stirrup became detached during the second week after splinting. Since the bird appeared more comfortable and was using the limb more appropriately without it, it was not replaced. At week 5, the splint was completely removed. A firm callus was palpable at the fracture site. An angle of approximately 15 degrees cranial to caudal between the fracture fragments remained, but function of the limb was determined to be adequate for release. Radiographs were not taken at this point or at initial presentation. The small size of the bones and type of fracture or callus would be difficult to evaluate radiographically even with high-detail, single-emulsion screens. Dental radiography equipment may be better suited to evaluate long bone fractures in tiny birds such as hummingbirds.

Outcome: The hummingbird was released 2 weeks after splint removal, at week 7, and immediately headed due south at high speed.

Management Implications

To the authors' knowledge, this is the first reported case of a captive diet resulting in a crop impaction in a hummingbird. The protein source used by the finder was only slightly soluble in sugar water. The calcium caseinate precipitated not only in sugar water, but also in the bird's crop, where it apparently congealed and was inaccessible to proventricular proteases. This unexpected finding re-emphasizes the import of providing *soluble* amino acid sources for hummingbirds in captivity, when they are unable to eat insects.

Products Cited

Vital HN™
Ross Consumer Relations
625 Cleveland Avenue
Columbus, OH 43215-1724
USA
Tel: 800/986-8510

Casec™
Mead Johnson
Evansville, IN 47721
USA
Tel: 812/429-5000

Pancrezyme®
Daniels Pharmaceuticals, Inc.
Jones Pharma Inc.
1945 Craig Road
St. Louis, MO 63146
USA
Tel: 800/525-8466
Fax: 314/469-5749

Nektar Plus™ and Tonic-I™
Guenter Enterle Enterprises
27 West Tarpon Ave.
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USA
Tel: 727/938-1544

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To Contact the Authors

Lauren V. Powers, DVM, ABVP
Timberlyne Animal Clinic
110 Banks Drive
Chapel Hill, NC 27514
USA
Tel: 919/968-3047

Janine Perlman, PhD
11207 Yosemite Valley Drive
Little Rock, AR 72212
USA
E-mail: jpandjf@swbell.net

Seasonal Changes in Arctic Hare (*Lepus arcticus*) Diet Composition and Differential Digestibility

by Nicholas C. Larter

ABSTRACT: The composition of plant tissues in the stomach contents and fecal pellets of arctic hares (*Lepus arcticus*) on Banks Island is described for summer, early winter, mid-winter, and late winter to assess seasonal differences in diet composition and relative differential digestibility of forage groups consumed. Hare diet was dominated by arctic willows (*Salix arctica*) throughout winter; in summer it became more diverse and legumes (*Astragalus alpinus, Oxytropis Maydelliana*) predominated. The proportion of forages in the diet determined by analyzing stomach contents was not significantly different from that determined by analyzing fecal pellets during all time periods. No forage classes were over- or underrepresented in fecal pellets in any time period. Summer availability of willows on Banks Island could be substantially reduced following winters when high numbers of arctic hares and muskoxen (*Ovibos moschatus*) had fed on arctic willows.

KEY WORDS: arctic hare, *Lepus arcticus*, muskoxen, *Ovibos moschatus*, Peary caribou, *Rangifer tarandus pearyi*, lemmings, *Dicrostonyx torquatus*, *Lemmus sibiricus*, diet, forage availability, digestibility, Banks Island, Northwest Territories

NICHOLAS C. LARTER, PhD, is the caribou/muskox biologist for the Department of Resources, Wildlife & Economic Development, Government of the Northwest Territories, Canada. He recently completed a 5-year field program investigating various aspects of the Banks Island ecosystem. Part of this study addressed seasonal changes in the quality and amount of forage available for, and the diets, of Peary caribou, muskoxen, arctic hares and lemmings.

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On Banks Island, Peary caribou (*Rangifer tarandus pearyi*), muskoxen (*Ovibos moschatus*), arctic hares (*Lepus arcticus*), and lemmings (*Dicrostonyx torquatus*, *Lemmus sibiricus*) are the only resident nonavian vertebrate herbivores. Peary caribou and muskoxen, the two major herbivores on Banks Island, show dramatic seasonal shifts in diet composition and diet overlap (Larter and Nagy 1997). As part of a study of seasonal range use and herbivory on Banks Island, the author documented the diet of arctic hares during summer, early-, mid- and late-winter to: (1) determine what forages were consumed on a seasonal basis, (2) determine if differential digestibility of forages occurred during different seasons, and (3) document any potential impact hares might have on forage availability for other resident herbivores.

Arctic hare diet has previously been documented only three times; for summer and late-winter on Axel Heiberg Island, Northwest Territories (N.W.T.; Parker 1977) and for summer and late-winter in northern Greenland (Klein and Bay 1991, 1995). There are no data on hare diet from the western High Arctic. Parker (1977) analyzed plant fragments found in the stomachs of arctic hares shot in summer (3 July to 3 August) and late-winter (23 March to 6 May) to determine diet composition. Klein and Bay (1991) analyzed plant fragments found in freshly deposited summer fecal pellets and from pellets assumed to have been deposited during the previous winter to determine diet composition.

Klein and Bay (1995) compared summer diet composition of arctic hares determined by analyzing plant fragments found in feces with plant fragments found in stomachs. They indicated that summer diet composition of arctic hares determined by the analysis of fecal plant fragments required correcting because of differential digestibility of forages. Whether or not to correct for differential digestibility in winter diets was discussed but not resolved (Klein and Bay 1991, 1995). Larter and Nagy (1996) showed little difference in the February diet of Barren-Ground caribou (*Rangifer tarandus*) when diet was determined either by the analysis of plant fragments in the rumen or the plant fragments in the feces, and questioned whether differential digestibility was an issue during winter. Use of a correction factor for diet composition determined during summer may be inappropriate for winter.

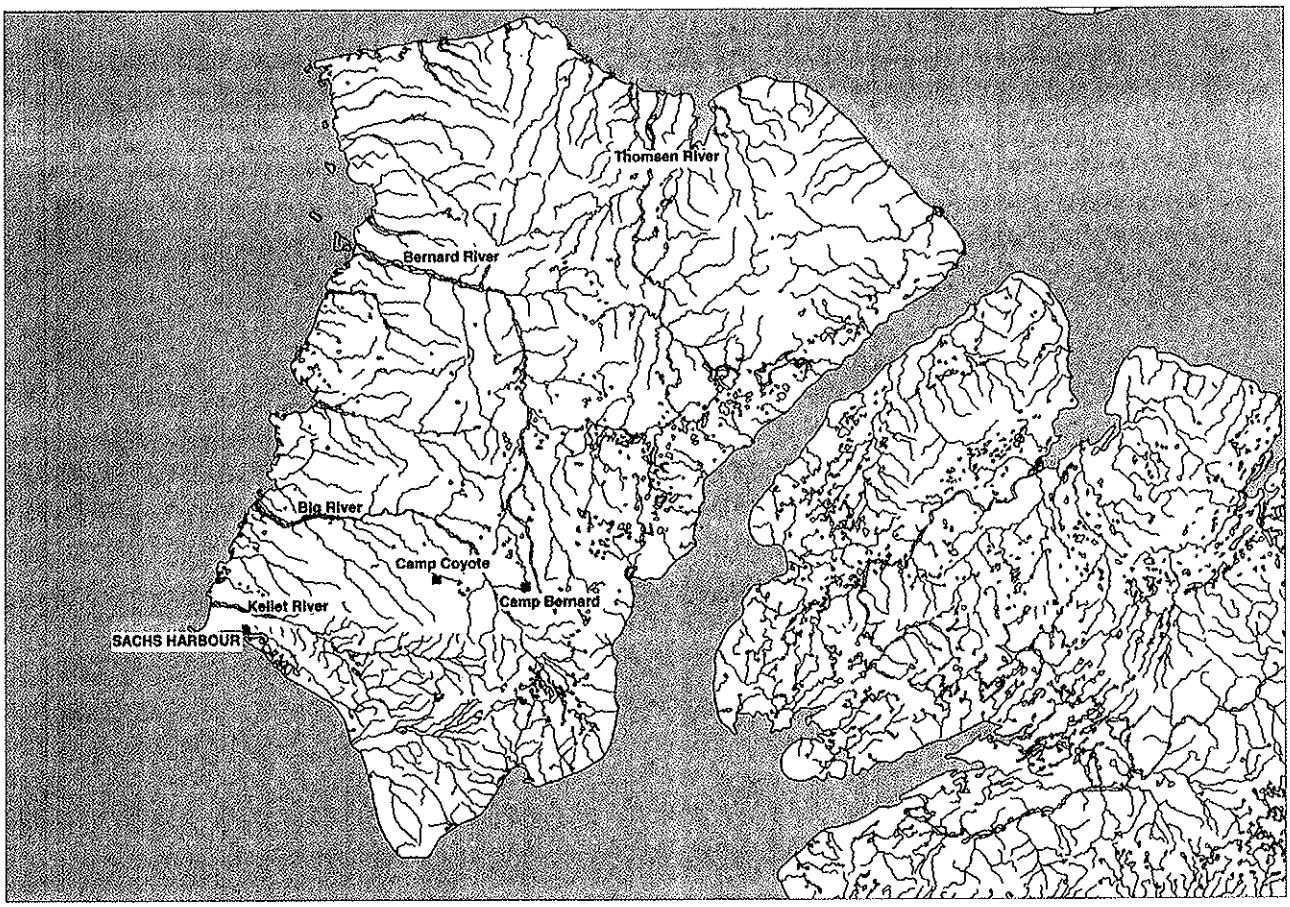
Forage availability is reduced by snow cover and herbivore foraging during winter. Winter occurs during most of the year in the High Arctic. Larter and Nagy (1997) documented increased winter use of willows by muskoxen on Banks Island during the 1990s when compared to the 1970s. The muskoxen population had increased from ca. 3800 in 1972 to ca. 65,000 noncalves in 1994. Peary caribou utilize willows during summer as a primary food source. Willow comprises ≥ 80% of the July and ≥ 40% of the June and August diet of caribou (Larter and Nagy 1997; N. Larter and J. Nagy, unpublished data). Reductions in summer willow availability caused by increased cropping of willows during winter could affect the caribou population. The potential impact of small mammal herbivory on the dynamics of forage availability has largely gone unreported.

In this article the author (1) documents seasonal changes in the diet of arctic hares on Banks Island obtained by analyzing plant fragments in feces and the stomach, (2) assesses differential digestibility of forage groups on a seasonal basis by comparing plant fragments found in the feces and the stomach, and compares these findings with those of Klein and Bay (1995), and (3) discusses the potential impact hares may have on forage availability for other resident herbivores of Banks Island. Botanical nomenclature follows Hultén (1990).

Study Area

Banks Island is the most western island in the Canadian Arctic Archipelago and covers an area of approximately 70,000 km^2 (Figure 1). The climate is Arctic mari-

FIGURE 1. THE STUDY AREA, BANKS ISLAND, NORTHWEST TERRITORIES



All hares were collected in upland habitats during travel between Sachs Harbor, Camp Coyote, and Camp Bernard.

time along coastal areas where weather stations are located, tending toward Arctic desert inland. Winters are long and cold: mean monthly temperatures are below 0°C from September through May; mean minimum daily temperatures range from -30° to -40°C from December to March. Summers are short and cool: mean maximum daily temperatures range from 5° to 10°C from June through August. Precipitation is low with an annual mean of 9 cm (Zoltai et al. 1980). Sachs Harbour is the only permanent settlement on the island (71° 59′ N, 125° 17′ W), with a population of 125.

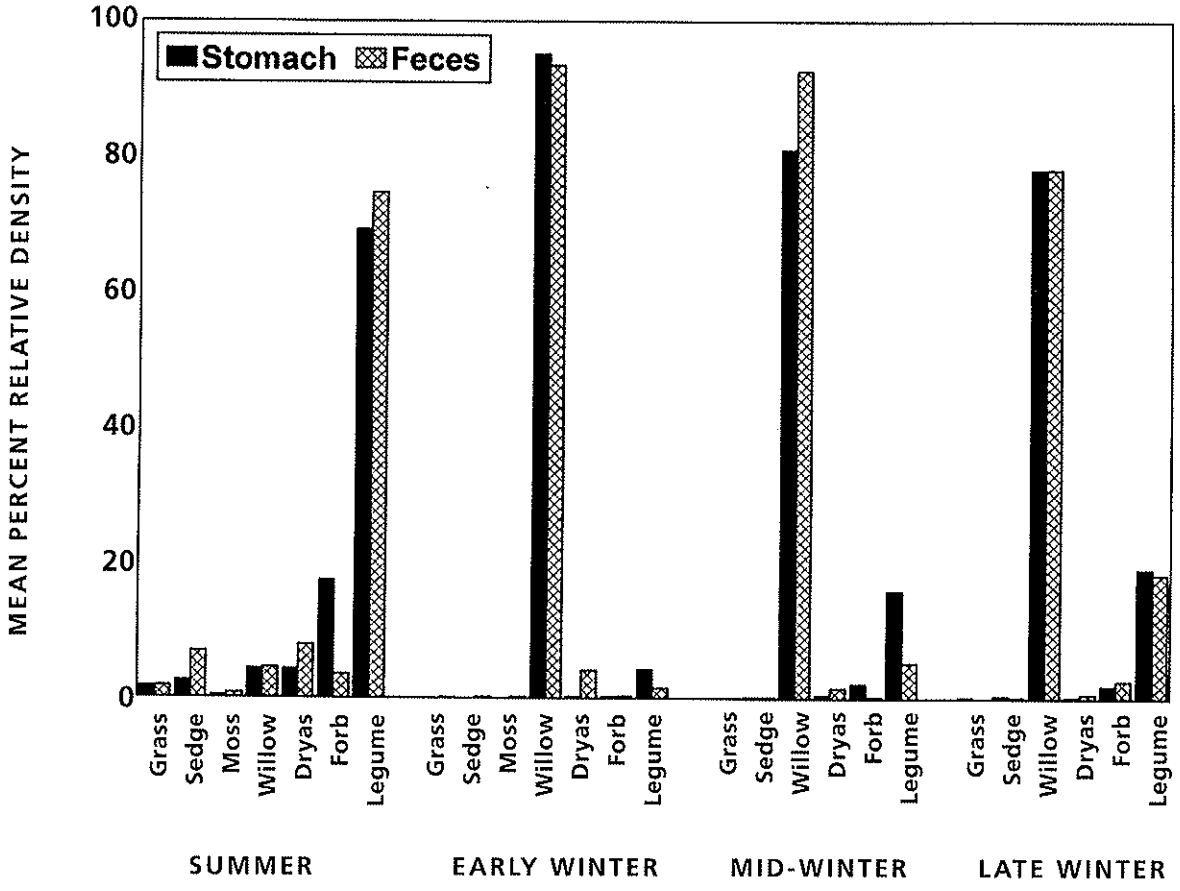
Habitat types have been adapted from Kevan (1974), Wilkinson et al. (1976), and Ferguson (1991). There are four major terrestrial habitats: (1) wet-sedge meadow; (2) upland barren; (3) hummock tundra; and (4) stony barren. Wet-sedge meadows generally are level hydric lowlands characterized by water sedge (*Carex aquatilis*), cotton sedge (*Eriophorum scheuchzeri*), and tundra grass (*Dupontia fisheri*). Upland barrens are moist well-drained sites occurring on the upper and middle parts of slopes. Vegetation is dominated by mountain avens (*Dryas integrifolia*) and arctic willow (*Salix arctica*) with legumes and a variety of forbs also present. Hummock tundra occurs on moderately steep slopes characterized by individual hummocks, which are vegetated primarily by dwarf shrubs, including mountain avens, arctic willow, and arctic heather (*Cassiope tetragona*); legumes and a variety of forbs are also present. Stony barrens are sparsely vegetated (<10% cover) with a coarse gravelly substrate. This habitat is located on windblown areas, ridges, gravel, and sand bars.

In 1994 numbers of Peary caribou appeared to have stabilized at ca. 800 while muskoxen numbers had increased to ca. 65,000 noncalves (Larter and Nagy 1997; Nagy et al. 1996). Local and scientific knowledge indicate that numbers of arctic hares show periodic noncyclical highs. Based upon the Inuvialuit Harvest Study program, arctic hares are currently high (1996–98) and were high from 1986–88 and from 1992–94. Lemming numbers have shown a four-year cyclical pattern with high densities during the summers of 1993 and 1997 (Larter 1998).

Methods

During field work conducted periodically on south central Banks Island (72°12′ N, 123°30′ W) from July 1993 through April 1997, 17 arctic hares were shot: 3 during summer (July and August), 3 during early winter (November), 8 during midwinter (February), and 3 during late winter (April). Whole stomachs and fecal pellets, collected from rectal/colon area, were collected from each animal and kept frozen until trans-

FIGURE 2. SUMMER, EARLY-, MID-, AND LATE-WINTER DIETS OF ARCTIC HARES ON BANKS ISLAND, DETERMINED FROM ANALYSIS OF PLANT FRAGMENTS FOUND IN STOMACH CONTENTS AND FECAL PELLETS



ported to the laboratory in Inuvik. Stomach contents were removed. Stomach contents and fecal pellets were air dried for 48 h to remove excess water, oven dried at 60°C for 48 h, and then ground (0.1 mm screen). A mixed ≤ 2 g subsample was analyzed microhistologically (Sparkes and Malechek 1968), following the method outline in Hansen et al. (1976) at the Composition Analysis Laboratory, Fort Collins, Colorado. Microscope slides prepared from each sample were examined within 100 fields of view to differentiate plant tissues. Data are presented as mean percent relative density of plant fragments. Major forage classes were grass, sedge, legume (*Astragalus alpinus*, *Oxytropis Maydelliana*), willow, mountain avens, forb, and moss. One sample had unidentified forb material in it (0.47%) and was placed in the forb class for the analysis.

The author used the Wilcoxon signed-rank test (Conover 1980) to compare forage class proportions determined from stomach samples with forage class proportions determined from fecal pellets for all four time periods. Moss was absent in mid- and late-winter diets; therefore it was not included in the statistical analyses for those time periods. Since forage classes were not independent and to provide a better comparison, Klein and Bay's (1995) data was reanalyzed using the Wilcoxon signed-rank test.

Results

All hares were shot in either upland barren or hummock tundra habitats regardless of season. Summer diet of arctic hares was the most diverse and was dominated by legumes (mean 69.3 and 74.7% as determined from stomach contents and fecal pellets, respectively). Early-winter diet was almost exclusively willow (mean 95.2 and 93.5% as determined from stomach contents and fecal pellets, respectively). Willow predominated in the diet in mid- and late-winter, while legumes increased in the diet as winter progressed to ca. 20% in late-winter (Figure 2). The proportions of each forage group in the diet determined from stomach contents, were not significantly ($P>0.05$) different from those determined from fecal pellets within any of the four time periods. No forage classes were over- or underrepresented in fecal pellets in any time period.

Reanalysis of Klein and Bay's (1995) data using the Wilcoxon signed-rank test concurred differential digestibility of forage classes. Forbs were significantly ($P<0.05$) underrepresented in the feces, while both sedge and grass were significantly ($P<0.05$) overrepresented in the feces.

Discussion

Summer (July and August) diets of arctic hares were documented from Axel Heiberg Island, N.W.T., by analyzing stom-

ach contents (Parker 1977), and from northern Greenland, by analyzing both stomach contents and fecal pellets (Klein and Bay 1991, 1995). As in this study, summer diets were a mix of grass, sedge, and forbs (including legumes), with <20% willow. Grass was a greater proportion (>40%) and forbs (including legumes) were a lesser proportion (<35%) of the hare diet on Axel Heiberg Island and in northern Greenland (Parker 1977; Klein and Bay 1995). On Banks Island, grass was minor (<2%) proportion of the diet; forbs (including legumes) were the greatest proportion (>75%). The low proportion of forbs in the diet of hares from northern Greenland and Axel Heiberg Island may result from low availability. Legumes are absent in Greenland north of ca 75°N latitude (D. Klein, pers. comm.) and are absent on Axel Heiberg Island (M. Raillard, pers. comm.). The low proportion of grass and high proportions of forbs (including legumes) on Banks Island may be related to availability. Grass was only present in 21% of 1474, 0.125 m^2 lots randomly located in the four major terrestrial habitats of Banks Island during range work in the 1990s while 66% of those same 1474 plots contained forbs (including legumes) (N. Larter, unpublished data). Forage availability, other than sedge, was not addressed in other studies of hare diets (Parker 1977; Klein and Bay 1991, 1995).

Hare diets in winter have been documented for late-winter (23 March–6 May) on Axel Heiberg Island, N.W.T. (Parker 1977) and for samples assumed to have been pooled over the entire winter from northern Greenland (Klein and Bay 1991). Willow dominated the late-winter diet on both Banks and Axel Heiberg Islands, however the late-winter diet on Axel Heiberg Island was almost exclusively willow (>92%). Early- and mid-winter diets of hares on Banks Island were almost exclusively willow, but by late-winter willow was ca. 80% of the diet. Willow generally represents a substantial amount of above ground biomass in all habitats year round and was present in 29% (242 of 1474) of plots in the four major terrestrial habitats of Banks Island (N. Larter, unpublished data). The winter diet of hares from northern Greenland was mostly forb (ca. 50%) and willow (ca. 40%) with some graminoids (ca. 10%). However, because all winter fecal pellets were collected in the following summer and pooled, comparisons to the author's results are limited.

The difference between Klein and Bay's (1995) findings of differential digestibility of summer forages consumed by hares, and the author's findings may have been a result of: (1) reduced sample size, (2) different numbers of forage classes used in the analyses, (3) the diet of Banks Island hares being dominated by two forage classes (legumes in particular), or (4) a real lack of differential digestibility in the forages consumed. Klein and Bay (1995) had a larger number of summer samples (n = 10) than this study (n = 3) and the author's samples showed little individual variation in diet. Klein and Bay (1995) included six forage classes in their analysis (grass, sedge, moss, willow, dryas, and forb), while this author subdivided the forb class into forb and legume and had seven classes in the analysis. To determine what effect the number of forage classes had, the author combined his forb and legume classes and reanalyzed the data. The results showed the forb (including legumes) class was underrepresented in the feces by only 8% (P = 0.10), compared to a 78% underrepresentation (P = 0.015) found by Klein and Bay (1995). The summer diet of hares on Banks Island was more diverse than winter, but not as diverse as that of hares in northern Greenland. No single forage class made up ≥55% of the summer diet of hares in Greenland, while a single forage class made up at least 77% of the summer diet of hares on Banks Island.

Differential digestibility of forages, in particular dicots, has been documented for collared lemmings (Rodgers and Lewis 1985). Collared lemmings selected dicots over monocots in feeding preference trials (Batzli and Jung 1980). Based upon the low proportion of sedge in the diet of arctic hares in northern Greenland and Axel Heiberg Island relative to sedge availability (Parker 1977; Klein and Bay 1994), and the apparently low digestibility of sedge, Klein and Bay (1995) suggested that arctic hares are not adapted to use sedge. Sedge used by hares on Banks Island was negligible and availability was high; 75% (1104 of 1474) of the vegetation plots contained sedge (N. Larter, unpublished data). The lack of sedge and the prominence of willow and legume in the Banks Island arctic hare diet is consistent with their suggestion.

The lack of differential digestibility in forages during winter is likely related to forage quality. During winter all forages are essentially freeze-dried and weathered, relatively more fibrous and less protein-rich, and therefore of low quality (Klein 1977). Studies determining the differential digestibility of forages have been generally conducted during the growing season when there is a wide range of forage quality levels between plants and within plant parts (Voth and Black 1973). Correcting for diet composition data determined from differential digestibility during summer should be limited to summer data only.

When populations are high, herds of hundreds of arctic hares are common on hillsides during winter and summer (J. Lucas Sr., pers. comm.; pers. observation). During winter, hares use their sharp claws and protruding incisors to remove snow and access forage. Given a winter diet almost exclusively of willow, high hare numbers could potentially consume substantial amounts of willow from hillsides during the dormant season. In the winter diet of muskoxen during the mid-1990s, willow use was 2–3 times greater than that found in the early-1970s (Wilkinson et al. 1976; Shank et al. 1978; Larter and Nagy 1997) and over the same time period the muskoxen population had increased 16-fold. The combination of high hare numbers and current muskoxen numbers may result in winter browsing levels that severely impact summer willow availability by either the physical removal of plant biomass during the dormant season and/or increasing plant mortality due to continued cropping of the previous years growth. Reduced new growth of willows during summer may affect the Peary caribou population, which relies on this growth as a primary food source during summer (Larter and Nagy 1997). Summer diet of collared lemmings during peak numbers is almost exclusively mountain avens (Larter 1998). The availability of mountain avens is high (70% of 1474 vegetation plots: N. Larter, unpublished data) and they are a small proportion of the diets of arctic hares, muskoxen, and Peary caribou. Therefore, high numbers of this small resident herbivore may have some localized effect on forage availability, but impacts would be minimal on hares, muskoxen, and caribou.

The diet of arctic hares on Banks Island is dominated by willow and legume throughout all seasons. The abundance of dicots and lack of monocots in the diet is more striking than that found in hare diets on northern Greenland and Axel Heiberg Island. Legume abundance may be unique to Banks Island as they are absent in the High Arctic of Greenland and Canada. The lack of apparent differential digestibility of forages during winter is similar to that found for Barren-ground caribou (Larter and Nagy 1996). Therefore, a correction factor for winter diets determined from fecal pellets based upon differential digestibility may well be unnecessary, especially for Banks Island. A correction factor for summer diets determined from fecal pellets may be warranted. Additional sampling and consideration of the role of caecotrophy are required to address this issue. However, given such a predominance of legume and forb in the summer diet of Banks Island hares, the practical utility of a correction factor may be limited. Winter foraging by high numbers of arctic hares in combination with current levels of winter foraging by muskoxen could reduce the availability of willow in summer for Peary caribou.

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To Contact the Author

Nicholas C. Larter
Department of Resources, Wildlife & Economic Development
Government of Northwest Territories
Inuvik, Northwest Territories
X0E 0T0
Canada
Tel: 867/777-7295
E-mail: nic_larter@gov.nt.ca

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Managing the World's Largest Oiled Wildlife Response

by Barbara Callahan

ABSTRACT: Oil spills happen worldwide and impact thousands of animals annually. While the sources of the spills vary, the end result is often that many pelagic and other aquatic birds are oiled. In 2000 the bulk-ore carrier *MV Treasure* sank off the coast of Cape Town, South Africa, oiling more than 20,000 African penguins (*Sphenicus demersus*). International Fund for Animal Welfare (IFAW) responded by mobilizing their emergency relief team to help the local rehabilitation center, South African National Center for the Conservation of Coastal Birds (SANCCOB), manage the wildlife response effort. In total, 90.3% of the oiled penguins were rehabilitated and released. With all oiled birds one has a small window of opportunity in which to rehabilitate the animals and get them back to the wild before they start to succumb to medical and secondary problems related to captive care. Management of an oiled wildlife response is as important as the veterinary care given to the animals while they're in captivity.

KEY WORDS: African penguins, *Sphenicus demersus*, oil spill, project management, rehabilitation, volunteers, supervision, international response

BARBARA CALLAHAN is the Alaska regional representative for the International Bird Rescue Research Center and is also a spill team responder for IBRRC. She has a BS in biological sciences and came to IBRRC in 1997, after seven years with a local bird rehabilitation clinic in Anchorage. Callahan was part of the team on two international responses, in France and South Africa, in 2000.

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Introduction

On 23 June 2000 the damaged bulk-ore carrier *MV Treasure* sank off the western cape of South Africa between Dassen and Robben Islands, spilling more than 1300 tons of bunker fuel. These islands are, respectively, the world's first and third largest breeding colonies of African penguins (*Sphenicus demersus*). Dassen Island is home to approximately 55,000 African penguins, Robben Island to approximately 18,000 (Callahan 2001).

Shortly after the *Treasure* sank, the South African National Foundation for the Conservation of Coastal Birds (SANCCOB) was inundated with oiled penguins and the knowledge that there were thousands more to come (Callahan 2001). SANCCOB immediately called for the assistance of the International Fund for Animal Welfare (IFAW), which activated its Emergency Relief Team. In the case of oiled wildlife response, the IFAW Emergency Relief Team is made up of staff from the International Bird Rescue Research Center (IBRRC) and staff from the International Fund for Animal Welfare; all team members are experienced in wildlife rehabilitation and spill management.

With each new report, plans were adjusted to accommodate what would become the largest rehabilitation effort ever attempted. Jay Holcomb, executive director of IBRRC, directed a large, temporary facility at Salt River; Karen Trendler, executive director of Wildcare in South Africa, directed the effort at the permanent SANCCOB facility at Table View. Within five days of the spill, there were more than 10,000 penguins at the Salt River facility and several thousand more at Table View, and it was obvious that a larger supervisory team was needed. (In all, more than 20,000 oiled African penguins were rehabilitated through this effort [Callahan 2001]).

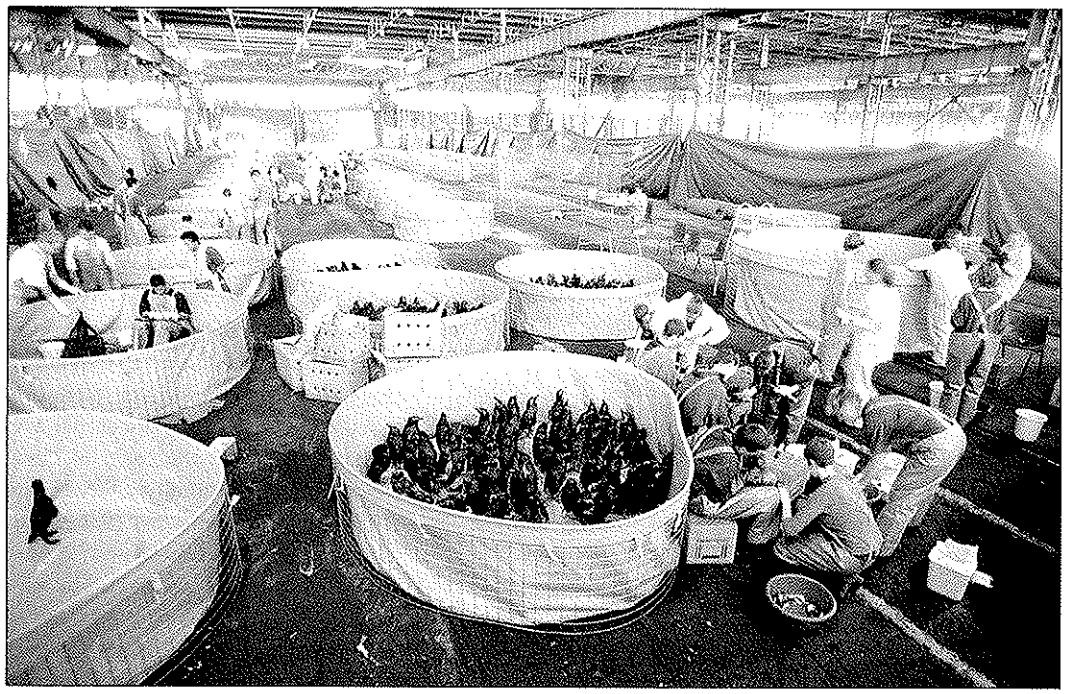
At this point, IFAW issued a worldwide call to zoos and aquaria for supervisory staff, experienced in captive penguin care, to come to Cape Town to augment the management team. Zoo and aquarium staff from 59 different centers (in 14 countries) responded. These supervisors were effective not only because they had experience caring for captive penguins, but also because their personnel management experience enabled them to supervise volunteers effectively. New team members were asked to make a minimum commitment of two to three weeks. The majority of these people obtained funding from their own organizations. The IFAW Emergency Relief Team was made up of about 50 people during most of the 10 weeks of the rehabilitation program. The team was then reduced to a couple of key managers who oversaw the remaining few hundred birds for an additional three weeks.

Logistics

The logistical needs grew proportionally to the number of penguins that came in oiled. The first requirement was to find a suitable facility to house the majority of the birds. The rehabilitation program would require a very large indoor space that had good ventilation to prevent the spread of disease (Tseng 1995, 215–17). The facility also had to have a good water supply that could be augmented by the use of fire hydrants in the area, as well as room for massive hot-water heaters. Space was also needed for offices (equipped with phone, fax, and computer lines); storage for food and supplies; the media who came to report on the effort; animal food preparation; bird washing, rinsing, and drying; medical care; and staff and volunteer support (food, restrooms, etc.).

There was a need for a huge outdoor area, where pens and pools could be constructed for birds to use after they were cleaned, while they were in the process of bringing up their waterproofing (Callahan 2001). Outdoor space was also needed for daily washing of all the bird pens and mats, as well as a large area for toilets, parking, and fish thawing.

Logistical staff from IFAW and SANCCOB worked together to secure a railway warehouse in the Salt River area of Cape Town within a few days of the spill. The



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At the Salt River rehabilitation center in Cape Town, each pen held between 60 and 80 penguins. The facility was set up in a former railway warehouse. Within days of the spill, the Salt River was the temporary home of more than 10,000 African penguins.

entire indoor facility was approximately 22,000 m^2, half of which was used for the penguin rehabilitation program. In addition, more than 24,000 m^2 (6 acres) were utilized outside of the Salt River facility.

Other logistical concerns needed attention. Some of the initial challenges were to fly team members in from around the world, have food and lodging secured for them, and provide transportation to and from the rehabilitation center. Meals were catered to the center, and the Emergency Relief Team quickly took over a moderate-sized hotel in downtown Cape Town.

The South African Red Cross provided much-needed volunteer support (such as tea and snacks), and throughout the project provided a fully staffed first aid trailer. The Cape Nature Conservation, the local natural resource trustees, took over supply acquisition and inventory control, and assisted in volunteer management and scheduling, transportation, fish acquisition, and disposal of garbage and fish waste. As fall approached, many of the effort's original volunteers left to return to college. During the last month of the rehabilitation program, Cape Nature Conservation supplied 50 full-time staff members to help with feeding and other jobs at the Salt River facility.

With any large-scale disaster, there is intense media attention; with oil spills, the wildlife aspect is always the most sought-after story. IFAW's media team issued daily press updates and arranged facility tours and special events.

The IFAW logistics staff performed numerous administrative duties and was charged with securing adequate food for the animals. It was important to use the highest-quality, fresh-caught pilchards (small herring-like fish, approximately 20 cm [6 in]). In the wild, African penguins eat this type of fish and it would be easily recognizable to the birds. Using fresh fish when possible meant that the birds would be getting all the necessary nutrients and vitamins needed. (Williams 1995). The local trustees issued special permits that allowed fisherpeople to increase their daily legal catch in order to provide enough fish for the penguins. Huge flat-bed trucks delivered thousands of kilograms of fish, three times per week. In all, more than 364,000 kg (400 tons) of fish were required; at the peak of animal care, 44,000 kg (10 tons) per day were used.

Management

Rehabilitation of oiled birds is a demanding task. Because the precipitating event is usually catastrophic in nature, a large number of animals are typically affected at once, as was the case in the *Treasure* spill. During the first week after the spill approximately 3500 penguins were brought to the SANCCOB's Table View facility and approximately 16,000 birds to the Salt River facility.

The coordination of such a rehabilitation effort is complex, multifaceted, and often daunting: not only do the animals need immediate and intense care, but the infrastructure for staff and volunteer support must be put into place simultaneous to the actual animal care. In addition, provisions must be made for moving the birds smoothly through the rehabilitation process. This can be one of the most difficult tasks for spill managers; without this preparation, animals will not move on to the next step in the process in a timely manner and this can lead to secondary medical and husbandry problems for the birds (Tseng 1999).

In the early days of a spill response, managers are concerned with getting the animals housed and stabilized. However, while crews work to provide warmth, fluid, and nutrition, managers have to be sourcing hot-water heaters, hoses, additional water, caging, animal food, and many other supplies. At the same time, pens and housing must be constructed for the next phase of the rehabilitation process so there is no delay, once the birds are stabilized and cleaned, in getting them into the waterproofing stage. This ability to anticipate animals needs and prepare for them is one of the cornerstones to mounting a successful oiled wildlife response.

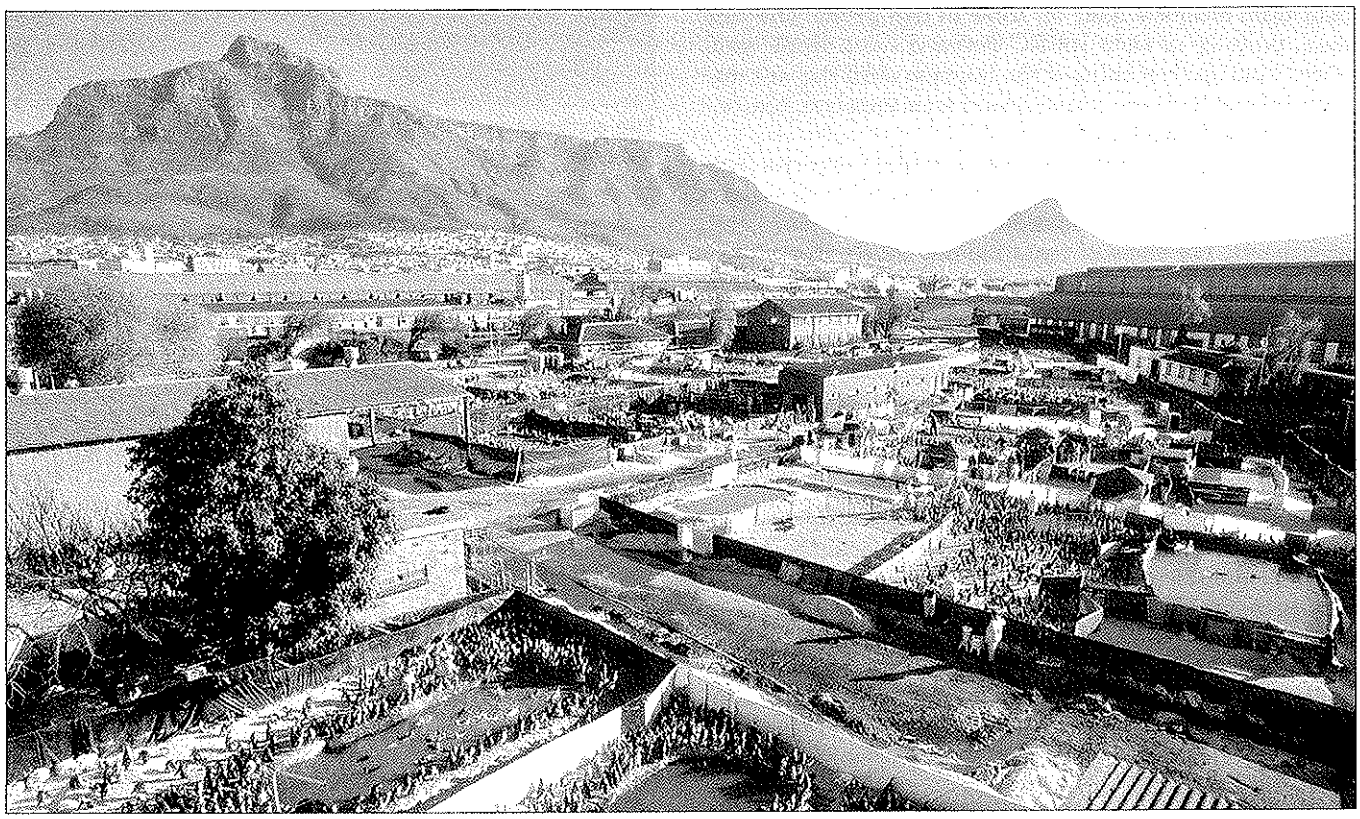
During oil spill responses, directors and trustees must use a herd health approach in managing the effort. This means that the best achievable care for the greatest number of birds is the priority, and triage of individual birds with problems that would prevent them from moving through the system quickly is necessary. In these situations, triage dictates the euthanasia of birds that have intensive care needs, such as substantial injury or disease, and certainly for animals exhibiting symptoms of conditions that might be contagious, such as *E. coli* and *Salmonella sp.* Critical evaluation by trained veterinary staff is imperative when working with such a large and vulnerable group (Callahan 2001).

Care was taken to minimize the possibility of major disease outbreak by ensuring good ventilation in the facilities, avoiding cage overcrowding, and paying close attention to cleaning protocols for cages, floors, food, and pools (Tseng 1995). Because such a substantial portion of the world population of African penguins—more than 25%—was impacted by the *Treasure* spill, the Cape Nature Conservation focused treatment on breeding birds: adults were given priority over chicks and juvenile birds during the evacuation, relocation, and rehabilitation program.

Due to the scale of this rehabilitation effort, IFAW made several deviations from its standard oil spill protocols; these changes could be implemented with no ill effects to the animals. In a break with standard procedure, birds were not bled on arrival or prior to being washed. Normally, packed cell volume and total protein would be evaluated for each bird upon intake and prior to washing, to ensure the stability of the bird (Tseng 1999). In this case, following protocol was logistically impossible because there were so many birds. Birds were stabilized with fluids, food, and resting time and were evaluated for 48 hours prior to washing. Normally, birds are given fluids by gavage several times per day. Providing the birds with supervised access to indoor pools (Callahan 2001) reduced the need to do this. While the penguins were not waterproof, or able to thermoregulate, they could be placed in pools that allowed them to drink, clean feces off their feathers, and get exercise, as long as the swim was kept short, five to 10 minutes per session. This allowed the birds to hydrate themselves, thereby lessening the need for labor-intensive gavage tubing.

Feeding boxes facilitated the otherwise overwhelming task of providing 20,000 penguins with adequate nutrition. Once the birds were clean and housed in outdoor pens, feeding boxes were instituted to reduce the stress of the animals, increase their daily intake, and cut down on the labor required to feed the penguins (Callahan 2001). Within three days of instituting the feeding boxes, almost all the birds housed outside had learned to take food from the hand, while in the box.

In an effort to reduce the time it took to rinse each bird, as well as the amount of water used, the rinse for the penguins was cut to five minutes (the normal time for rinsing an average bird is around 30 minutes; Tseng 1995). While this shortened rinse left soap on the birds, they were then placed in outdoor pens with access to very large pools for swimming and allowed to rinse themselves. Once provided with these large pools (and encouraged to swim for increasing lengths of time each day), the penguins were able to bring up their waterproofing within about a week. When the clean birds were first put in the outdoor pens, they were allowed free access to the shal-



JON HRUSA

The Salt River penguin rehabilitation facility.

low pools. This allowed the birds to hydrate themselves, get exercise and start the rinsing and waterproofing process. Supervisors in charge of swimming herded the birds into the large swimming/waterproofing pools with no haul-outs for mandatory swims. (No haul-outs were provided because non-waterproof birds will haul-out to get away from the cold water. If, however, they remain in the water long enough to start to get wet, when they are allowed to haul-out they will preen the wet spots, re-align their feathers and make those spots waterproof.) It was imperative that the birds were monitored for safety, to ensure that none became hypothermic or drowned. During the first day of outdoor pen living, the birds were swum two or three times, starting with 5 minute swims and working up to increasing lengths of time. Within approximately a week, the penguins were able to stay in the water without being wet or cold for up to an hour. Once they were able to stay in the water for an hour, they were checked for waterproofing.

After the birds were graded for waterproofing, passing birds were taken to a bleed station and a small blood sample was taken. Each bird was evaluated for anemia and nutritional status. Birds were also screened for avian blood parasites.

Working with University of Cape Town, Avian Demography Unit, each bird was fitted with a permanent metal band prior to release. This will help local biologists studying the African penguin and its population to monitor the birds after release.

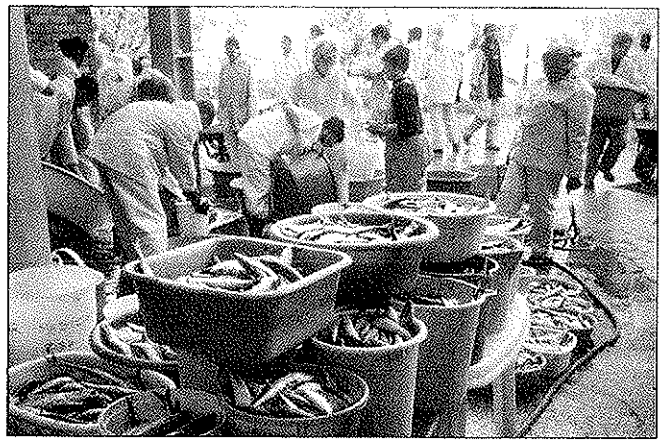
Staff and Funding

IFAW and IBRRC staff oversaw the IFAW Emergency Relief Team, which was composed of more than 130 individuals from 59 organizations worldwide. The team was kept at 40 to 50 people at all times during the rehabilitation program, and most team members came for three to five weeks. The core team, made up of eight IBRRC staff and seven IFAW staff, stayed from the beginning of the response until the vast majority of birds had been released; most team members were onsite for 10 to 12 weeks.

Immediately following the spill, a wildlife response incident command structure was put in place, with Estelle Van der Merwe, SANCCOB executive director, taking the lead as crisis manager. The chain of command was clearly charted, key positions were designated, and staff members were assigned to pivotal roles. The permanent SANCCOB center and the temporary Salt River Center both had center managers assigned to them, rehabilitation managers, veterinarians, washing supervisors, pool supervisors, feeding supervisors, and others. The incident command structure took into account the Cape Nature Conservation staff, SANCCOB managers and staff, IFAW staff, and IBRRC managers and staff.

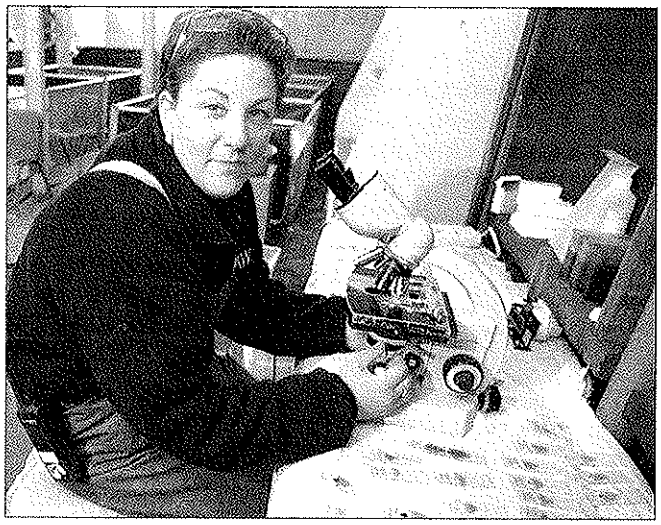
From the beginning of the response, local volunteers were used at both the SANCCOB and Salt River facilities. At the height of the response, more than 1000 volunteers were utilized each day; during the course of the 10-week response, a total of 45,000 volunteer shifts were needed. Some volunteers had received training in previous spills, others were accepted and trained on the spot and encouraged to come often to help with the oiled penguins. Volunteers were trained to feed and clean birds, take blood, grade birds for waterproofing, oversee swimming, and a host of other duties.

Within the first days of the spill, SANCCOB and IFAW were able to put in place a phone bank for volunteer scheduling. People could call in and schedule themselves on certain shifts. This allowed the supervisors to know that they would get the needed work force each day. The personnel at the phone bank were able to ask the volunteers about their experience and assign some of them to specific jobs. With this, as with any spill, the Emergency Relief Team was willing to train people, due to the great demand for labor.



BARBARA CALLAHAN

10 tons of fish were needed on some days. In all, 400 tons of fish were used.



JON HRUSA

The author screening blood samples for malaria and babesia.

Training volunteers on the job was part of the supervisor's duties. With the staggering number of animals, supervisors were assigned not only to each physical area but also to most of the major tasks that were performed daily. This meant that most supervisors could train new volunteers to do whatever job was at hand in that area. Many of the volunteers returned day after day and less training was needed as the spill continued.

Volunteering at an oil spill can be a very physically and emotionally demanding job. Often, volunteers are doing work that is unlike anything that they've ever done before, and in the midst of somewhat controlled chaos. In an effort to keep the volunteers motivated, positive, and focused, supervisors tried to explain to them what was happening with the rehabilitation effort in general, and what part they played in the overall response. Every job during an oil spill response is

important and the response team conveyed that to volunteers to its best ability. A simple "thanks for all your effort" goes a long way, as well. Volunteers were encouraged not to overwork but to come regularly as they became skilled in a particular area. As birds were beginning to be released in the local Cape Town area, volunteers were encouraged to take part in the release of the birds. This can be enormously satisfying and helped to keep the volunteers interested and motivated. Cape Nature Conservation provided drinks and snacks to the volunteers.

Total costs for the wildlife rehabilitation effort were approximately U.S.$2 million. Funding for the effort came from a variety of sources. Approximately U.S.$800,000 were committed by IFAW; there were substantial donations from other organizations around the world, including SANCCOB. In addition to IFAW's major financial commitment (both cash and in-kind staff contributions), many individual zoos and aquaria funded supervisory staff for varying lengths of time.

At this time, SANCCOB and IFAW are working with the insurance company for the *Treasure* to try to recoup some of this money. During the response, IFAW and SANCCOB were told that the insurance company had run out of money and was closing its doors. The current status is unknown at this time.

Management Implications

Experience has taught the response team agencies that several things need to happen in order to achieve the best success during an oiled wildlife response. Having experienced and trained staff ready, available, and mobilized immediately to implement a clear management system (with a strong chain of command) with a highly defined focus on what is best for the animals helps to greatly reduce the initial chaos of a disaster. A centralized facility that can house the bulk of the animals and staff helps limit the logistical concerns and increases the ability of staff to care for the animals. Within the management system, there must be clearly defined roles and responsibilities and a solid understanding of how the system functions. The IFAW Emergency Response Team worked to communicate clearly by meeting daily and concentrating on the important issues of animal care, health and human safety, volunteer management, and logistical concerns. The Emergency Response Team believes that the most effective way to manage a response is by keeping the focus solely on what is best for the animals and how much time is necessary to move them through the rehabilitation system.

Conclusion

The IFAW Emergency Response Team tries to bring its experience to each effort, and to make the task satisfying for all involved. This attitude helps to build team enthusiasm, commitment, and support to deal with the emotional impact that often accompanies working in a spill response environment. Such efforts often require a large volunteer force, and managing the volunteers can be a big job. It is the response team's experience that when volunteers feel involved, they give it their all. Every job in the rehabilitation program is essential, and when volunteers understand the role they play in the whole scheme, they work hard and remain committed to the process.

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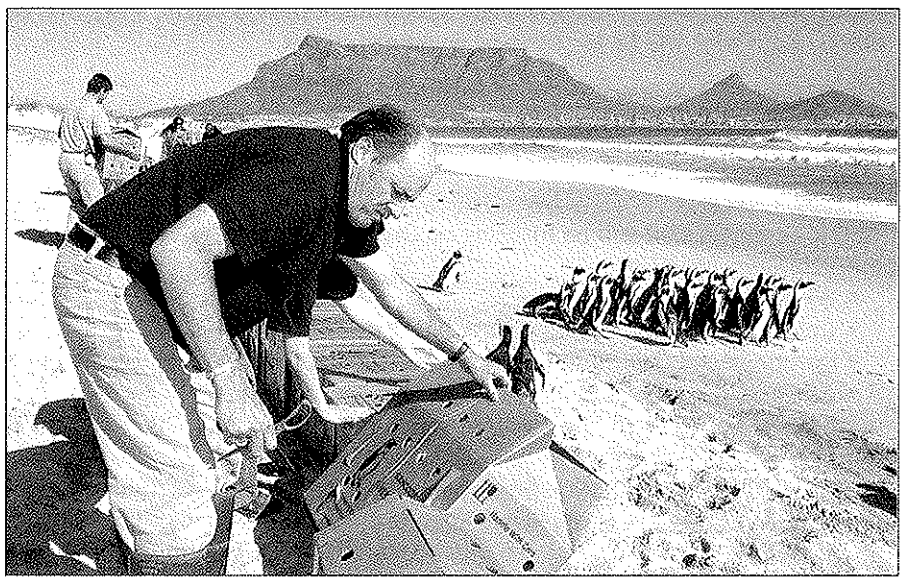
To Contact the Author

Barbara Callahan
International Bird Rescue Research Center
Alaska Wildlife Response Center
6132 Nielson Way
Anchorage, AK 99518
USA
Tel: 907/562-1326
E-mail: ibrrcbarb@aol.com



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Jay Holcomb, executive director of the International Bird Rescue Research Center, helping release rehabilitated penguins on Cape Town beach.

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project WILD is one of the most widely used conservation and environmental education programs among educators. At this lively and engaging day-long professional workshop, educators will be introduced to project WILD materials, activities, and strategies. Through hands-on practice, educators gain the experience and confidence needed to work with their students and to integrate project WILD into their programs. The project WILD K–12 Activity Guide and a Certificate of Completion are provided to those who participate.

Field Trips:
Our fabulous field trips are on Tuesday, November 13, featuring two all-day excursions. Trip one is a day of birdwatching on Merritt Island National Wildlife Refuge and Canaveral National Seashore, where you may be able to observe such species as Peregrine falcons, bald eagles, roseate spoonbills, as well as jays, terns, pelicans, and many more.

The second trip will take you to Wekiva Springs State Park for a day of canoeing, hiking and picnicking, where you might spot wildlife such as otters, alligators, and hawks. Both trips will be led by local volunteer guides.

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November 14–17

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COLUMN

Operating Instructions

ORPHANED SONGBIRDS

by Nathalie Karvonen

If you work with birds, no doubt you dread the coming of spring. One after another, the calls come in describing babies who "fell from their nest" or "can't fly because they surely have a broken wing." This column will address basic "orphaned" nestling and fledgling bird issues. If you can intervene in the situation early, many fledglings can be left right where they are. With creativity, nestlings can be reunited with their parent(s) as well.

Gather some basic information. Let the caller tell you what is going on, take notes, and then ask questions.

Ask the caller where the bird is. Ideally, they have called you before picking the baby up. If not, make sure the baby is in a box in a quiet place. Vague questions like, "Is the baby bird in a safe place right now?" may mean an entirely different thing to the caller than to you. Clenched in their child's hand, in a budgie cage on the kitchen table, or sitting on the dog's back (yes, that happened once) are *not* "safe" places!

Ask the caller about finding the baby. When did they find it? What situation was it in? If the baby was found a week ago, or was passed through most of the neighborhood children, chances are you'll have to admit it. Was it found in "normal" or a dangerous situation? One of our callers had rescued a gosling from the middle of a 16-lane highway!

Were cats involved? If the baby was in a cat's mouth or being batted around by a cat, it must be admitted. If there was a cat nearby, you may want to have the caller bring the baby in to be checked; if it is uninjured, you can send it right back.

Next, get a detailed description of the baby. Is it bigger than a parakeet? Smaller than a robin? Does it have feathers? What color are they? Do the feathers completely cover the baby's body? Does it have a long tail or a short stubby one? Does it have any mottles, stripes, or other markings? Ask the caller to describe the bird's beak.

The baby's behavior will help you to determine species and age. Is the baby opening its mouth for food? If not, it may be an injured adult or a sick baby, but may also simply be an older fledgling that is nervous around people. A baby who is "running," as opposed to "hopping," may be a precocial bird such as a killdeer or duckling. Knowing this would change the instructions you give the caller.

Could there be parent birds in the area? Ask the caller if they see birds around. Try to determine what species they are. How many are there? Do they seem interested in the baby? Some birds, especially crows, may dive-bomb people who approach their babies. Other birds sit quietly out of sight. Just because the caller doesn't see them, doesn't mean that they are not nearby.

Determine if the baby is sick or injured. Are there any obvious wounds or blood? If the baby tries to flutter its wings, do they both flutter the same way? Does it hop on both legs? Does it fall to one side? Does its head tilt? Are the baby's eyes closed, even if it's old enough that they should be open? Is it fluffed up? Does it have its head tucked under one wing? If there is reason to believe the baby is sick or injured, admit it—even if there are parents in the area.

At the Toronto Wildlife Center we rely heavily on the "poop test" to determine if the bird's parents are in the picture. (If the parents are feeding the baby, it will need to poop regularly.) If the bird sounds like a healthy fledgling, we ask the caller to put the baby in a shallow, open-topped box in the same location where it was found. If there is imminent danger from predators, provide protection by mounting the box in a nearby bush or tree. After an hour, check for feces. If the bird has pooped, and if the poop appears healthy (i.e., a little sac with a white part and a dark part), then the parents are likely feeding the baby. Make sure the caller has not been feeding the baby before conducting this test.

A healthy fledgling in a normal situation should generally should be left where it was found. If the caller is concerned about predators (especially cats), you may choose to have them place the bird in a box as described above. (The baby may, however, jump right out.) If the baby is seen later and the caller is still concerned about parental care, ask them to do the poop test again.

If the nestling seems healthy and its nest is known, ask the caller to pop the baby back in. If the nest has blown down, have the caller build a "fake" nest. Based on the best guess of which species it is, along with the size of the bird, give detailed instructions on which materials to use, and what size and shape the nest should be. The babies must fit snugly into their new nest, with their legs tucked up under them, and be able to lift their back ends over the edge of the nest to poop. The new nest should be placed within a few feet of where the old nest was and should be sheltered from the elements.

Making tough decisions

Calls about babies bring tough decisions; these are literally life-or-death situations. Thinking through your reponses now—when you are not in the pressure of the moment—will make the spring months much easier. If you get a call about a healthy fledgling with its parents feeding it, but where the neighborhood is teeming with cats, are you going to "kidnap" that baby because of what might happen? Or will you concentrate your efforts on educating the public about cats? What if the bird has fledged into a dangerous area? If the caller insists on raising the baby, will you instruct them how?

It is important to fully understand what the caller is dealing with. Many people call in injured small adult birds as babies simply because of their size. Many fledgling birds—even those with parents caring for them—become sick or injured. You are the expert. Make sure you know as much as possible before giving advice. You can make all the difference to that little bird your caller has.

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

THINKING OUTSIDE THE BOX...OF SLIDES

by Kieran Lindsey

What in the world did educators do before the invention of the slide projector? Without colorful pictures to illustrate pertinent points, speakers had to rely on other resources...like their own imagination and that of the audience.

The slide projector (and recently the computer projector) is a helpful appliance, no doubt. But it has become so ubiquitous in education programs that it has turned into a kind of crutch—a safe and predictable conservation message delivery device. Both the speaker and the audience know what is expected of them: the speaker will deliver a logical, linear narrative; the audience will listen passively and ask a few polite questions; then coffee and donuts will be served in the vestibule.

Slide presentations are not without merit. A picture is still worth a thousand words, and the right photo can invigorate, incite, or inspire an audience. But the slide projector should be one of many tools in an educator's bag of tricks.

Why? Because we all have different ways of learning. Some of us are visual animals; others respond best to sounds. Both of these groups have their needs addressed during the typical slide-based education program. But many of us are tactile creatures—we need to touch things to understand them. We're Raccoons in a world that caters to Hawks and Bats.

As educators, we don't want to turn our backs on the tactile learners, especially since many in this category are from the milk-and-cookies set, those small folk who find it hard not to fidget unless placed in front of a television. You know: the audience every one of us is desperately trying to reach.

So what's the first step you need to take to reach out to the Raccoons? Well, you can start by stepping outside the box—the slide box, that is—and into a trunk. Discovery Trunks are a great way to bring the excitement of nature into a classroom. In addition, they're convenient, inexpensive, and they work.

There are four steps in creating Discovery Trunk programs: (1) planning, (2) development and collection, (3) packaging, and (4) maintenance.

Planning: Begin by setting a budget. Discovery Trunks may be simple or elaborate or something in between, but you need to know at the start how much you can invest. Next, choose the subject matter for a trunk, for example, wetlands wildlife or endangered species. As with the development of any education program, the hardest part is knowing what to leave out. That's where themes, once again, come to the rescue. Establish a theme statement using the method described in the spring 2001 installment of this column. Finally, you'll need to think about who will keep track of scheduling and maintaining the trunk(s).

Development and Collection: With your theme statement in hand, you can begin gathering items to place inside the trunk. Choose between five and nine main concepts that relate to the theme and make a list of materials that could be used to illustrate each one, noting possible sources or donors at the same time. Keep durability in mind: the contents of Discovery Trunks are meant to be touched and explored. Laminated samples of plants used for food or shelter hold up well to repeated handling. If you want to use tapes of animal calls or other sounds, have extra copies of the recording in reserve and choose a simple, sturdy tape player designed for use by small children. Puppets are always popular Discovery Trunk items, as are felt story boards. You might want to include instructions for appropriate games from the *project WILD K–12 Activity Guide* or *Sharing the Joy of Nature*. Check with your local fish and wildlife department if you want to use feathers, bones, furs, and nests. Don't forget to include a list of the trunk's contents.

Packaging: Flexible plastic containers work well, as they are sturdy, lightweight, and colorful. Think about who will need to lift and carry the trunk, and how much weight can they be expected to handle safely. Will the speaker need a luggage cart to transport the trunk from a vehicle to the presentation site? The trunk should not be packed so full of goodies that it's a struggle to stuff everything back inside at the end of each program. And make sure the lid can be secured to prevent the contents from spilling out if the trunk is dropped.

Maintenance: The contents of a Discovery Trunk should be checked against a master list each time the trunk is checked in or out. Broken, overused, or missing items will need to be replaced, so it's a good idea to keep extras on hand.

There's one more thing you'll need to do to create a successful Discovery Trunk, but since it's really a process, I didn't count it as a step. Continually assessing the effectiveness of the trunk's contents is vitally important. Encourage those who use the trunk to tell you if the directions are easy to follow, if the background information is helpful, and which activities are most popular with audiences. Don't take criticisms personally—after all, education programs should be a learning experience for audiences and teachers alike.

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.*

JWR

COLUMN

By the Book

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

Q Recently the U.S. Fish & Wildlife Service (USFWS) has made clear that an annual report need not include a list of every migratory bird received, the name and address of the person finding the bird, and the nature of each injury. Instead, the report requires a summary of the year's rehabilitator activities in the form of lists of the total number of individuals of each species handled and the distribution of possible dispositions (euthanized/expired, released, pending, transferred).

In an annual report for use of educational birds, is it still necessary to list the date of each presentation; name of each audience group; number of attendees divided into age groups; subject matter covered; each separate protected specimen, live (bird) and nonliving (nest, individual feather, bone, egg shell) used; and future itinerary of scheduled presentations?

A You need to comply with the conditions on your permit. I am pleased with the new rehab reporting requirements. They are patterned after the regulations and are reasonable. If a permit administrator (PA) or a Special Agent wants more detailed information, they can inspect your records.

Record-keeping requirements for rehab and for educational birds are the same and are in 50CFR13.46 and 50CFR21.27(c)(1). Accurate, complete records are important for centers to keep besides the requirement to do so. Use the records you are required to keep to complete the annual report. If the regulations or your permit conditions don't require you to keep certain records, I don't know how you could be expected to report them. Records indicate effort in and effort out. You need to know what the cost of doing business is and record keeping helps. I never heard of a requirement to report how often you use each nest, feather, bone, and egg shell.

Some of the specific requests on the Special Purpose Possession—Live Permit reporting form ensure that you are using the birds you have permits for. The PA also wants to know how active you plan to be the following year.

Q Many rehabilitation groups maintain unreleasable birds for use in educational programs that range from classroom presentations to appearances at state fairs and "festivals," as well as high-visibility sites such as car dealerships and "nature" stores. The wildlife groups like the public visibility these appearances provide, and the venues benefit from the presence of live birds. Clearly there is cost entailed in presenting these programs. Businesses often wish to demonstrate their support of the wildlife group with financial contributions and like this to be recognized. Is it illegal to charge for programs using animals covered by educational permits?

A It is important to remember the underlying authority and the purpose for possessing live migratory birds. Currently, no specific regulation allows for the possession of migratory birds for education, public display, or foster parenting. However, 50CFR21.27 allows the issuance of Special Purpose Permits for activities that benefit migratory birds, involve research, or other compelling reasons. This is the same regulation under which rehabilitation permits are issued. Always consult your permit and your PA with a specific question.

Nothing in the laws or regulations prohibits you from charging for programs. There certainly are many expenses involved in keeping your birds healthy, and most of the permittees I know charge a fee for some of their programs.

A related question would be: Is it legal to present programs at commercial establishments? One special condition on possession permits states that birds held under your permit *may not* (emphasis theirs) be displayed in a manner that implies representation, promotion, or endorsement of products, merchandise, goods, or any business, company, corporation, etc. *except* (emphasis mine) you may promote your educational activities or the USFWS.

This special condition was developed by all the PAs and is now included on all possession permits nationwide. Just what does it mean and how does it effect you? As an enforcer, this is how I interpret it: These birds are entrusted to permittees for specific purposes, namely public display, education, and foster parenting, and that is all they should be used for. Schools are one ideal place for education programs. Does the condition mean that you can only go to public schools because a private school is incorporated and a business? Some regions allow programs in a mall's common area (a mall is an incorporated business in and of itself), but not in a shop within a mall. All this is confusing.

As a permittee, every program (no matter where it is presented) must present a conservation or science message. If a tire store is enlightened enough to pay for a program for their staff or customers, then that is appropriate. Give your program, promote your organization, give a good word for the USFWS for allowing you to do this, thank the sponsor, and cash their check. You are not there to promote their product or services; you are there to give a message, the same as if you were in a classroom, a church (also a corporation), or your own facility. If your PA interprets this differently then you need to communicate with them and with your appropriate Special Agent.

Q Sometimes commercial advertising agencies ask permission to take pictures of wild birds for use in advertisements. Is it illegal to use education birds in commercials? Are rehabilitators precluded from accepting donations of money from the public or such companies for the privilege of photographing birds held under an educational permit?

A Although related to the previous discussion, this question presents an entirely different set of circumstances. As the Migratory Bird Treaty Act states, you can't do anything with migratory birds unless authorized. A Special Purpose Possession Permit authorizes you to use the birds for education, public display, and foster parenting. It does not authorize someone else to exploit them for commercial purposes. You cannot control what someone does with pictures they take at one of your programs, but orchestrating a special opportunity for someone to take pictures with the express purpose of commercial exploitation is inappropriate and would violate a condition of your permit.

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@aol.com.

JWR

COLUMN

Food for Thought

MICRONUTRIENTS—PART I: THE WATER-SOLUABLE VITAMINS

by Astrid MacLeod and Janine Perlman

Micronutrients are essential nutrients that are present in the diet, and needed by animals, in relatively small amounts, compared to carbohydrates, protein, and fat. They are generally categorized as vitamins and minerals, although some micronutrients are neither of these.

Vitamins and minerals are further subdivided into water-soluble and fat-soluble vitamins, and macrominerals and microminerals. Here we investigate the water-soluble vitamins; other micronutrients will be treated in future columns.

Very early in the last century, researchers discovered that pure, defined diets of water, carbohydrates, protein, fats, and minerals did not support animal life. Other nutrients were required. The first vitamin, which reversed a syndrome known as beriberi, was isolated by a Polish biochemist in 1912; it turned out to be thiamin, or vitamin B_1. The discovery of other vitamins followed relatively quickly. The water-soluble vitamins include the B vitamins (of which there are eight), and vitamin C.

Most individual "vitamins" are actually some number of similar molecules, called *vitamers*, which the body converts to usable vitamin form. Vitamers are biochemicals, made by living organisms, yet by definition they are not made, or made in sufficient quantities, by "higher" vertebrates. They are generally synthesized by plants and/or microorganisms. Once they are transformed into active vitamins by animals, the animals themselves, as prey, become sources for the vitamins. Adult ruminants require no B vitamins in their diet because their gut flora make all eight members of the B-complex.

Much of our knowledge about vitamins has come from studies on animals commonly used for experimentation (laboratory or commercially raised species), and/or from findings in humans. Less is known about the needs of wild species. However, like other nutrients, the water-soluble vitamins play roles in very basic biochemical processes. The reasons that they are needed, or mechanisms by which they work, are relatively universal in vertebrates. Species differences are likely to be quantitative (in the amounts of vitamins required), rather than qualitative (whether they are needed at all, or major variations in the way they work).

All micronutrients are so basic to the interconnected biochemical reactions of life that, if they are present in the wrong amounts, they generally create a domino effect involving many processes other than those in which they're directly involved. Some vitamins are involved in the synthesis or utilization of other vitamins.

Most of the water-soluble vitamins are so intimately involved in basic metabolism that deficiencies result in a range of general symptoms. In growing animals, in particular, deficiencies can be manifested in broad and severe problems. In adults, the onset of symptoms may be more gradual and somewhat more specific. A number of factors contribute to the particular symptoms displayed, including species of animal, age, and *nutriture* (nutritional status) with regard to other dietary elements. It is also common for animals to contract (and succumb to) infectious diseases that are, in fact, secondary to vitamin deficiencies.

Here we describe deficiency symptoms for vitamins only if they are both relatively universal among species and diagnostic.

With one exception, water-soluble vitamins are not stored in the body, and they need to be continually present in the diet. They are relatively nontoxic in amounts exceeding requirements. That is because the kidneys can excrete excesses relatively easily. However, any substance, including vitamins, can be toxic at sufficiently high levels, and, as discussed below, excesses of some vitamins may cause problems before others.

The B-Complex

This group, or complex, of vitamins, are called "Bs" for historical reasons. However, except for their water-solubility, they have little in common with each other in terms of their chemical structure or specific functions. Nevertheless, they are all intimately involved in basic metabolic reactions. Many of them are cofactors (necessary additional "parts") of enzymes that perform those reactions. Others are intermediary compounds that accept and donate small, crucial parts of important molecules that are part of the breakdown of glucose for energy, or the synthesis of DNA, for example.

As noted earlier, **thiamin,** or vitamin B_1, was the first vitamin to be isolated and identified. Thiamin is a cofactor for enzymes involved in obtaining energy from food. Thiamin is necessary for enzymes that make sugars that are, for example, components of nucleic acids (DNA and RNA) and for enzymes that are involved in the synthesis of such crucial substances as fatty acids. Thiamin is also required for normal nerve cell function, though not as an enzyme cofactor. That role results in the classic deficiency symptoms of nervous system abnormalities, of which "stargazing" is a common one. Diets high in carbohydrates result in a higher requirement for thiamin because it is used in many reactions of carbohydrate metabolism.

Thiamin is widespread in whole foods, but it is quite unstable (destroyed upon storage) and is easily processed out of food—by water, milling of grains, and so forth. There are some substances that destroy thiamin, called thiaminases, notably found in raw fish. For that reason, thiamin is routinely added to raw fish immediately before feeding to wildlife; otherwise, the diet is likely to be thiamin-deficient.

Riboflavin, or vitamin B_2, is yellow. It gives B-complex tablets their yellow color, and it imparts a yellow or orange hue to urine when present in levels that exceed requirements.

Riboflavin is needed for oxidation-reduction reactions crucial to extracting energy from food. It is also involved in the synthesis of some neurotransmitters.

Although it is synthesized only by plants and microorganisms, this vitamin is bioaccumulated by animals, and is mainly found in foods of animal origin. The yellowish hue of egg "white" (albumen) is contributed by riboflavin. Because of its water-solubility, it is easily lost in processing; it is also sensitive to sunlight.

Niacin is also known as vitamin B_3. It is a cofactor for more than 200 enzymes, most of which extract energy from food. It is also involved in the biosynthesis of fatty acids, steroids, and DNA.

In humans, niacin is used as a drug to lower blood cholesterol levels (this requires physician supervision); its mode of action in this capacity is unclear.

Of the water-soluble vitamins, excesses of niacin are problematic at lower levels than most. When supplementing diets with B-complex, it is wise to use niacin or pyridoxine (below) as the limiting vitamins, because they are toxic before the others. In addition, niacin is comparatively stable in storage, which is another reason for caution when supplementing.

Niacin can be synthesized, to various extents depending on species, from dietary tryptophan (an amino acid). For that reason, niacin requirements also vary between species.

Many meats, legumes, and grains are good sources of niacin.

Pantothenate is part of Coenzyme A, which is a cofactor for numerous enzymes central to both breaking down foods to obtain energy and to storing energy in the form of synthesized fatty acids. Pantothenate also helps metabolize some drugs, participates in the formation of the neurotransmitter acetylcholine, and aids in healing.

The name of this vitamin derives from the Greek *pantos*, meaning everywhere, and, indeed, pantothenate is widely distributed, particularly in animal-based foods.

It is unstable when exposed to heat or moisture.

Biotin was once known as vitamin H. It is a cofactor that, when joined to an enzyme, transfers CO_2 (activated carbon dioxide, which in the cell is actually an organic acid), from one molecule to another. It is necessary for energy storage (e.g., fatty acid synthesis) when there is sufficient food and for breaking down molecules to release their energy, when needed. It allows the metabolism of certain dietary amino and fatty acids.

Biotin is found in a variety of foods and is also made by gut bacteria. As for other vitamins synthesized by gut flora, antibiotic treatments can contribute to biotin deficiencies. It is fairly stable in storage, though it is subject to oxidation.

Avidin is a protein in raw egg white that binds very tightly to biotin and makes it unavailable. For that reason among others, raw egg white should not be fed routinely or in large amounts. Avidin is inactivated by cooking.

Vitamin B_6 is a group of vitamers that include pyridoxine (from plants) and pyridoxal and pyridoxamine (from animals). It is a cofactor for a very large number of enzymes, most of which are involved in amino acid metabolism. It is also required for making a number of important biochemicals, including heme (in hemoglobin), niacin from tryptophan, histamine (a molecule that signals inflammation), and some neurochemicals. It is involved in mobilizing glycogen to make glucose, and it modulates the action of steroid hormones.

Very large amounts of vitamin B_6 are toxic to humans, so it would seem advisable to supplement diets for wildlife with some care. It is relatively stable in storage (except if exposed to light), which provides another reason for caution in supplementing.

Whole grains, nuts, and animal-based foods, are good sources of this vitamin.

Folic acid, or folate, has the most vitamers of any vitamin. Not only does it come in many forms, so that the folate content of food is difficult to measure and quantify, but its bioavailability is also highly variable.

Folic acid serves as an intermediary; it transfers one-carbon groups from one biochemical to another. In this way, it is involved in the metabolism of several amino acids, and in the synthesis of the bases ("letters") of DNA and RNA.

Folic acid interacts with other micronutrients. It is protected from degradation by vitamin C. It appears to form a complex with zinc in the gut, although this is not well characterized. It works synergistically with vitamin B_{12} (below), and without adequate B_{12}, it cannot be regenerated after use in biochemical reactions.

Very high doses are toxic, and they can also mask symptoms of vitamin B_{12} deficiency until irreversible neurological damage has occurred.

Green leafy plants, legumes, and some fruits are good sources of folic acid; like other vitamins, it is also obtained from whole prey. It is moderately unstable in storage.

The vitamers named **cobalamins**, or vitamin B_{12}, are unique in that they are made only by microorganisms. Vitamin B_{12} is found, however, in animals, which bioaccumulate it. It is also unique by virtue of the fact that, unlike other water-soluble vitamins, it is stored for long periods in the body.

Cobalamin is a cofactor required for the metabolism (both synthesis and breakdown) of several amino acids.

Sources of vitamin B_{12} include animal-based foods and feces, which animals obtain using the time-honored practice of coprophagy.

Cobalamin bioavailability in the gut is reduced in the presence of vitamin C.

Vitamin C

Ascorbate, or vitamin C, is an interesting vitamin, in that many animals that evolved after fish can synthesize all that they need under most conditions. However, primates, fruit bats, guinea pigs, and an assortment of birds have lost the ability to synthesize this vitamin and require it throughout their lives.

Other species have been shown to need dietary ascorbate while young and rapidly growing. Additional species that nominally do not require it have been shown to fight infections better when it is added to their food. Organophosphate poisoning results in higher requirements, as well.

Vitamin C is required at higher levels when an animal is stressed for any reason. We therefore suggest that the diet of *any* animal in captivity should supply ascorbate.

Ascorbate is found in some fruits and vegetables, and in the kidneys and/or liver of vertebrates. It is relatively unstable in usual storage conditions. When eaten concurrently with other nutrients, it can affect their uptake. It increases absorption of iron and heavy metals, decreases absorption of copper, and reduces uptake of vitamin B_{12}. It is needed in the body for the regeneration of folate.

Vitamin C has a number of roles. It participates in collagen (connective tissue) synthesis, which is why people's

teeth may fall out when they have scurvy (the deficiency disease). It is required for the oxidation of fatty acids, for the metabolism of tyrosine (an amino acid), and for the synthesis of several neurotransmitters. It is an important antioxidant.

Antioxidants are crucial for health because free radicals, highly reactive chemical species, are continuously formed in the body. Unless they are "quenched" by antioxidants, they lead to chain reactions that cause phenomena leading to many diseases such as atherosclerosis (hardening of the arteries) and cancer. Antioxidants will be treated in greater depth in subsequent columns.

Vitamin C may provide a model for thinking about how to feed wildlife. Many species that "shouldn't" require ascorbate *do* require it, under a range of conditions. The same may be true of a number of nutrients, and for a wide range of animals. The necessary nutrients may be chemicals with which we have little familiarity, while the species that we rehabilitate are surely ones whose nutritional requirements are not well defined.

For that reason among others, one of our highest priorities must be to supply animals in our care with a variety of whole, natural foods that are as close as possible to what they would eat in nature.

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

Astrid MacLeod *is a writer and experienced avian rehabilitator who works for Manitoba Conservation (formerly the Manitoba Department of Natural Resources). She has researched avian nutrition for much of the past decade. Her e-mail address is sparrowl@mb.sympatico.ca.*

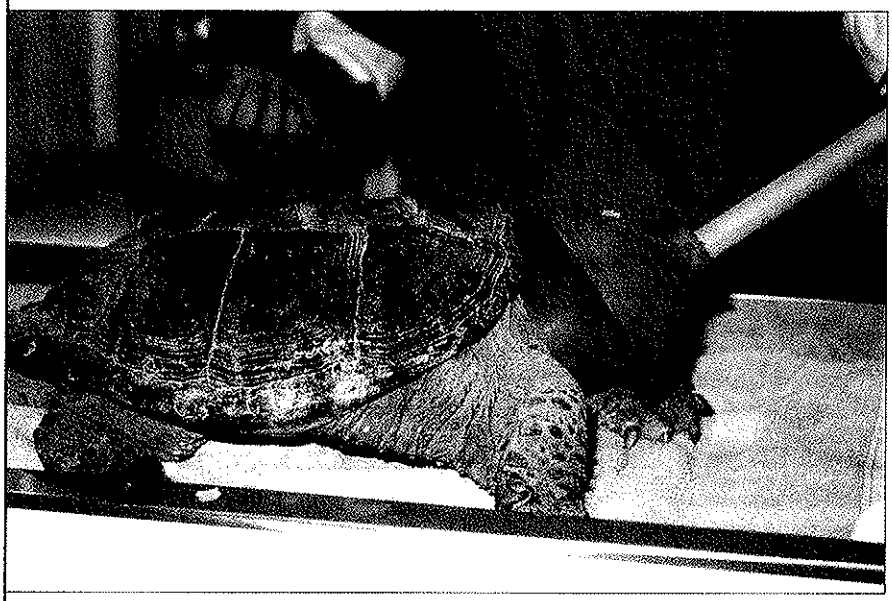
Janine Perlman, PhD, *is an avian rehabilitator and has conducted laboratory research in biochemistry and molecular genetics for twenty years. She can be contacted at jpandjf@swbell.com.*

JWR

SIMPLE SOLUTION

An Innovative Approach to Snapping Turtle Restraint

by Lynn Whited



One of the many challenges faced by wildlife rehabilitators is the ability to safely handle wild animals without the assistance of chemical immobilization. This can be a daunting task and often requires some ingenuity on the part of the rehabilitator. This article describes a simple technique used to restrain even the surliest of snapping turtles at the Wildlife Center of Virginia.

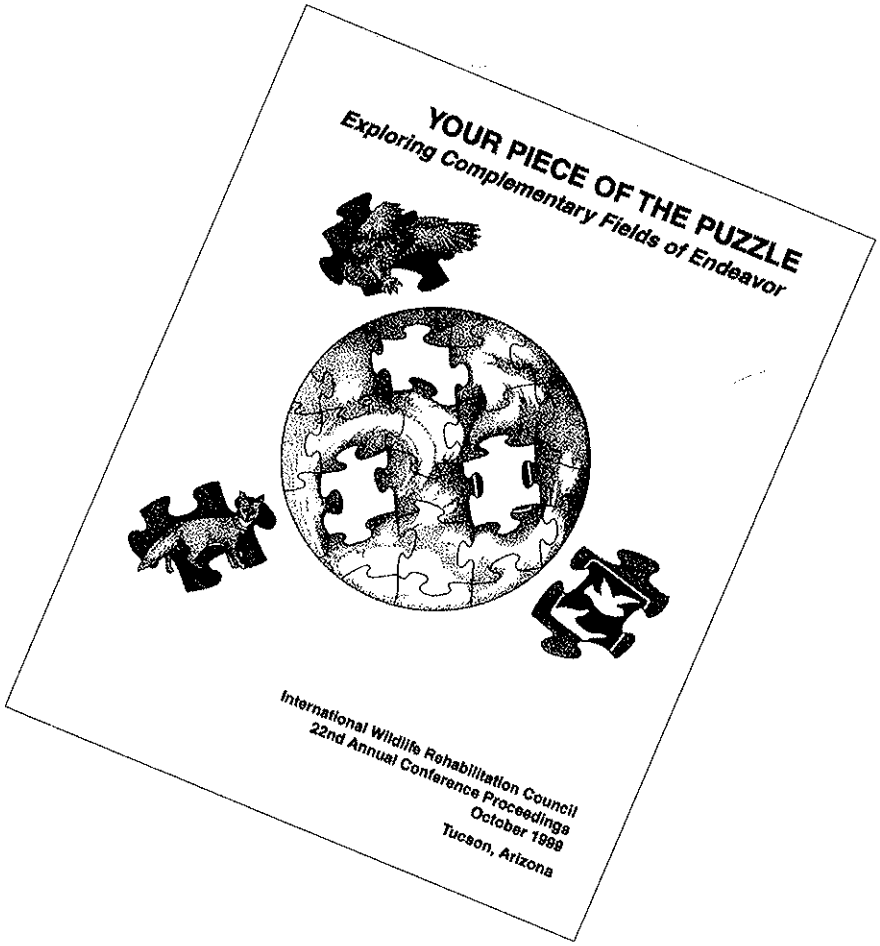
Snapping turtles are one of many misunderstood and maligned creatures. Most of the snappers presented to the Wildlife Center of Virginia are victims of either a deliberate or an accidental hit by car encounter. Due to turtles' aggressive disposition and ability to inflict severe bites, many rehabilitators may not wish to work with these magnificent reptiles. With the help of a simple household implement, rehabilitators can safely examine and treat injuries to the shell or extremities.

The snapping turtle's main defenses are its mouth and claws. Because they can react with lighting speed, it is of the utmost importance to have the head sufficiently restrained before performing a complete exam. To simply and safely restrain the head of a snapping turtle, place it inside the rubber end of a plunger. The long handle allows the restrainer to apply the plunger at a safe distance and maintain control of the head without having to touch the animal. The person performing the exam can safely check the turtle for injuries without fear of being bitten. Plungers that have a bell-shaped end with a hole at the bottom work best. This technique has worked well for daily shell cleaning and administering injections. A quick assessment of the head can be obtained by allowing the snapping turtle to bite the wooden handle. Any examination of the mouth is best performed under anesthesia.

This form of restraint is only used for initial physical exam and for routine procedures that are not going to inflict severe pain to the animal. All minor or major surgical procedures are performed under general anesthesia.

Lynn Whited, DVM, is a veterinarian at the Wildlife Center of Virginia.

There's no need to miss the information...



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Conservation Classics: *Sharing the Joy of Nature*

by Joseph Cornell
Reviewed by Kieran Lindsey

Nevada City, Calif.: Dawn Publications, 1989
167 pp; U.S.$9.95
ISBN: 0916124525

There's a mantra used within the wildlife rehabilitation community and just about every other conservation-based group in existence. We've probably all said it more times than we could begin to count. It sounds something like this: "The key to saving wildlife and wild places is education."

Few would argue with that statement, least of all me. But in spite of the fact that I love helping others learn about and appreciate wildlife, from time to time I feel overwhelmed by the magnitude of this task. That's when—even as I'm giving a presentation or the words of this mantra are leaving my mouth—a mutinous question crosses my mind.

"Why?"

Why is education the key? Why not common sense and good science? Why do I and others like me have to spend so much time trying to help other people see the importance of caring for this planet—people who, by and large, seem to prefer malls over mountains and mountain lions. Why can't we simply roll up our sleeves, set aside the habitat, place filters on the smokestacks, clean up the rivers, and be done with it?

I found the answer several years ago in a book by Joseph Cornell: education is the key because the care of rivers (or mountains, or mountain lions) is not a question of rivers, but of the human heart.

Like it or not, humans are the ones calling the shots at this point in history. If we are to have any hope of success, we've got to open those hearts. In order to develop an attitude of reverence for life, we need to begin with awareness. Helping people to develop that awareness is the focus of Cornell's books—and his life.

Cornell spent his childhood years exploring the marshes, rivers, and mountains near his hometown of Yuba City, California. When he was unable to find a college major that mirrored his interest in outdoor education, he designed his own bachelor's program in nature awareness at California State University, Chico. Cornell then received formal training as a naturalist from the National Audubon Society. He published his first book, the classic *Sharing Nature with Children*, in 1979. Soon after, he founded Earth Sky, a nonprofit environmental education program, to share his methods and philosophy with adult leaders and teachers.

Like its predecessor, *Sharing the Joy of Nature* is a collection of nature-awareness activities. In addition, Cornell introduces a collection of teaching methods and principles developed over decades of leading nature activities. He explains:

> ...I gradually realized that there was a sequence for using games and activities that always seemed to work best, regardless of a group's age, its mood, or the physical setting. I became convinced that the reason people responded so well to this particular sequence was that it's in harmony with certain subtle aspects of human nature. In time, I blended all the outdoor activities I'd ever collected or created into this natural way of teaching....I call the system Flow Learning, because it has four stages that flow from one into another in a smooth, natural way.

The four stages of Flow Learning are Awaken **Enthusiasm**, Focus **Attention,** Direct **Experience**, and Share **Inspiration**. The strategy allows educators to create an endless variety of nature experiences, each ideally matched to present circumstances and no two exactly alike. Although it is a structured system, it isn't rigid. Tens of thousands of educators who have read this book or taken Cornell's workshops can vouch for Flow Learning's flexibility and effectiveness.

The word *education* comes from the Greek for "to draw out or bring fourth." Joseph Cornell believes that anyone can develop the ability to help others draw inspiration from the wild world. Enthusiasm for nature, Cornell insists, is always based on personal experience. It's how our own passion for wildlife began—whether we remember a specific incident or not—and to generate lasting enthusiasm for nature we must give others their own experiences. This gentle, compassionate man has found a way to help us do just that.

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

Insectlopedia

Poems & paintings by Douglas Florian

Harcourt Brace, 1998
48 pp; U.S.$16
ISBN: 0152013067

Mammalabilia

Poems & paintings by Douglas Florian

Harcourt Brace, 2000
47 pp; U.S.$16
ISBN: 0152021671

These companion books of poetry and paintings are written with children as young as two years old in mind, but will be enjoyed by adults as well.

Full of fun, Florian pays homage to the often-neglected kingdom of the insect in *Insectlopedia*. *Mammalabilia* takes on the world of mammals in ways unique and unknown to most biologists.

Each poem is matched by an equally fanciful painting. Strong compositions with solid yet fast lines are a quick feast for the eyes. The text dances, wiggles, loops across the pages—a surefire method to engage the mind and bring out a smile.

"The Io Moth"

The io moth
Has mam-moth eyes
That are not real—
They're a disguise
To ward off birds
And other creatures,
Like garter snakes
And science teachers.

Closer to Silverstein than Yeats, Florian engages the child with wordplay. Often anthropomorphic and unconventional, he teaches, teases, and talks.

"The Lynx"

Some people wear coats of Lynx
I
Think
That
Stinks

Tell your friends and convert your enemies. These books have something for everyone.

Reviewer Jennifer Goyette is a natural history artist.

See How They Grow: Owl

by Mary Ling
Photographs by Kim Taylor

New York: Dorling Kindersley, 1992
This title is currently out of stock, but may be ordered used.
(Amazon Price: U.S.$8.95)
ISBN 1564581152

Die Eule, und andere Nachttiere

by Sylvaine Perols & Klaus Todt-Rubel

Bibliographisches Inst., 1995
U.S.$15.30
(www.NetStoreUSA.com.buch/122/341/3411087218.shtml)
ISBN: F3411087218

This summer my husband and I rented a camper and drove to view the solar eclipse in Zambia. We drove from South Africa through Botswana to a ferry over the Zambezi river at Kasungula, entering Zambia at Livingston. Arriving at the ferry in the afternoon, we thought it best to stop in the modest town of Kasane until morning. Better to arrive at the border early the next day.

"Ask K— where to stay," advised a fellow camper at the Marang hotel campgrounds in Francistown. Everyone in Kasane seemed to know K— and her advice was, "See if Gaby and Phil have room at their lodge." They did.

Climbing the open staircase toward the vaulted thatched ceiling of the lodge I had a distinct feeling of deja vu. But I'd never been this far south in Africa before. We settled in our room and watched the sun set over the Chobe River from a little veranda. Looking like tiny hummingbirds, some kind of sphinx moth was feeding on papaya blossoms in the dusk. Dinner was to be served at 7:30 so we descended for a drink around 6:30. The same familiar feeling met me on the stairs.

"Reeeeeeep!" said a voice. "Reeeep!" said another voice. That's what it is! It's not something I see at all, it's something I smell! The odor of young barn owls nesting nearby, and spat! came the whitewash from the top of the thatched roof. It seems Gaby and Phil love the owls and welcome them in through the veranda door as they return to feed the youngsters. The lodge couldn't be equipped with better mousetraps.

Owl is a most wonderful collection of photographs from the pipping egg and chick to the adolescent barn owl at 12 weeks old. Anyone doing rehabilitation on this living banshee would welcome the pictures, if only to help assess the age of new arrivals. Portrayed nesting a tree cavity, like some of our big cottonwood cavities, various events in the neighborhood are sketched in charming little drawings along the lower edges of the pages. The one-week-old chick portrayed with its newly hatched sibling (asynchronous hatch); a squirrel coming down the tree to check out the hole hurriedly changes its mind when threatened by Mom; the brancher out and exercising before a first flight are all accurate descriptions of events in the life of a young owl. The book is intended for children and is a gentle portrayal of the family. Though the point is subtly made that the owls are interested in mice and that Dad is a hunter who brings tasty things to eat, there is no illustration of furry prey actually being caught.

The only parameter missing in this description of a barn owl's beginnings was the absence of any mention of night. Perhaps night is so closely associated with these auditory hunters that the authors felt it goes without saying.

Not so with *Die Eule, und andere Nachttiere*.

This little spiral bound volume is magical. Transparencies show the owl from front and back, in a farmyard scene sitting cryptically on the top of a post and hunting in a meadow. The seizing feet of the raptor are individually drawn, as is the construction of feathers designed for silent flight. Pellets and their contents, and mutual grooming are all portrayed. Four different rodents and a small bird are identified as prey, with drawings of their remains from a dissected pellet. Little border pictures of stages of the owls development or a partner offering prey to the incubating parent enrich the pages.

A night scene of a cat watching a hunting owl from the roof of a barn moves the readers into the realm of other night hunters. When you look through

the window of the barn, one parent owl is feeding a mouse to four young.

Bats, also flying hunters of the night, are introduced as *keine vogel*. The same magical transparencies depicting a night exodus and nursery colony enliven the pages.

At the end, night birds of the world are mentioned, including oilbirds, goatsuckers, and kiwis—a truly international book. The fact that it is written in German makes it a little difficult for those of us who are language impaired to be fully instructed, but it's a definite visual treat, and with a dictionary one can even figure out the text. If you can find it get it!

How was the eclipse, you may ask? It was total, we saw two planets. The birds were a little confused, though. They started evensong at 3 p.m. Had to do it all over again at 6.

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

JWR

A Man Called Raven

By Richard Van Camp
Illustrations by George Littlechild

San Francisco: Children's Book Press, 1997
29 pp; U.S.$9.95/$15.95
ISBN: 0892391448

A Man Called Raven brings an ancient Native American legend into the present day. It shows both native traditions and culture, and the timelessness of certain moral lessons, such as the wrongness of cruelty and the need to respect the wild creatures who share the planet with us. George Littlechild's bright and powerful illustrations enhance the drama of this modernized legend.

Two young brothers have some bad habits, including disrespect and cruelty toward animals. One day the boys corner a raven and begin to hit it with hockey sticks. The raven finds an unguarded space and makes his escape, with the boys in hot pursuit. Suddenly the brothers find themselves face to face with an elder from their village. The craggy-faced, smelly man was very angry. He insisted on the boys telling him where they lived and made it clear that he would be speaking with their parents. The terrified youngsters went home to await their fate.

All is not cut and dry, however, as the story has a surprise ending that will keep children riveted to their chairs. Grade-school children through pre-teens are sure to enjoy this book.

Reviewer Marge Gibson is executive director of the Raptor Education Group Inc. in Antigo, Wisconsin.

JWR

Editor's Note: *This issue of the* Journal of Wildlife Rehabilitation *offers readers reviews of children's and young people's books, with the upcoming holiday—and gift-giving—season in mind.*

SELECTED ABSTRACTS

AVIAN

Ptilochronology Reveals Differences in Condition of Captive White-Throated Sparrows

K. D. Jenkins et al.
Condor. 2001. 103(3)

Ptilochronology is a technique in which the growth rate of a feather is used as an assay of a bird's condition. Two important questions remain regarding this decade-old technique: (1) does the daily rate of feather growth correspond closely with changes in nutritional status during feather growth? (2) for which stressors can ptilochronology be used as a reliable assay? Using an experimental manipulation of diet, the authors tested the effectiveness of ptilochronology for assessing nutritional condition in male white-throated sparrows (*Zonotrichia albicollis*). Their hypothesis was that birds given an ample diet would be in better condition than those given a subsistence diet, as indicated by faster feather growth. In a second experiment, the authors examined the effect of a stressor, low social status, on feather growth. It was expected that dominant birds would be in better condition and regrow feathers faster than subordinates because of their priority of access to food. Birds fed an enriched diet weighed more, grew longer feathers, and had wider growth bars than birds receiving a diet lower in protein and calories. Dominants retained more fat than subordinates, but did not grow significantly longer feathers or wider growth bars. However, within flocks, the differences in social status between the birds corresponded to differences in growth-bar width. The study's results support the validity of ptilochronology for directly detecting differences in nutritional status during feather regrowth, and point to a likely influence of social status, a density-dependent ecological stressor, on feather growth rates.

Translocation of Red-Cockaded Woodpeckers by Reciprocal Fostering of Nestlings

M. T. Wallace and R. Buchholz
J. Wildlife Mgmt. 2001. 65(2)

The endangered red-cockaded woodpecker (*Picoides borealis*), a nonmigratory, cooperatively breeding species limited to the older-growth pine forests of the southeastern United States, requires living pine trees for cavity excavation. Since the 1950s, alteration and destruction of critical woodpecker habitat have caused a decline in red-cockaded woodpecker populations. The red-cockaded woodpecker now exists mostly in small, scattered populations whose respective members have little opportunity to interbreed. In general, as populations become smaller and more isolated, the frequency of inbreeding increases and genetic diversity and population viability may decrease. The introduction of unrelated individuals into disjunct red-cockaded woodpecker populations may reduce inbreeding, maintain genetic variability, and reduce local extinction. The authors developed a technique for selecting red-cockaded woodpecker nestlings and transferring them into the nests of unrelated conspecifics. For each translocation, the authors paired nests by age and exchanged one nestling from each, so that two in-

troductions were made with one reciprocal translocation event. Nest visitation by the parents and fledging success of nestlings were monitored. Fostered nestlings were accepted by their new parents, and the rate of successful fledging by fostered nestlings was not different from that of nonfostered control nestlings. The authors concluded that reciprocal intraspecific fostering of similarly aged nestlings can be used safely and effectively to translocate red-cockaded woodpeckers and may have advantages over the translocation of adults and juveniles under certain conditions.

MAMMALS

Individual and Population-Level Variability in Diets of Pallid Bats (*Antrozous pallidus*)

D. S. Johnston and M. B. Fenton
J. Mammalogy. 2001. 82(2)

At two locations in California (coastal, Tocaloma; desert, Caliente), analysis of feces presented a significantly higher number of prey types for the diets of pallid bats (*Antrozous pallidus*) than analysis of culled parts of prey. Analysis of diet by culled parts was biased toward larger, harder prey, and some softer, smaller prey were missed altogether. Observation of individuals feeding revealed that some bats ate prey without culling any parts, whereas others culled only the hardest and largest parts. Analysis of feces from tagged adult male pallid bats from Tocaloma (1993–94) and Caliente (1994–95) suggested that bats were generalists, but whereas diets of individuals at Caliente reflected the average diet for the group, none of the individuals at Tocaloma ate the average diet. Variation in the diets of pallid bats reflects prey availability and individual foraging behavior. Tocaloma bats did not significantly change their diets throughout summer; Caliente bats did. Bats from Caliente and Tocaloma ate different prey than arthropods caught in pit traps, suggesting that bats in both populations were selective foragers. In captivity, hunting pallid bats took flying and nonflying prey. Some flying prey were forced against a surface before capture, adding a novel dimension to the range of behavior involved in "gleaning."

Facultative Torpor in Free-Ranging Black-Tailed Prairie Dogs (*Cynomys ludovicianus*)

E. M. Lehmer et al.
J. Mammalogy. 2001. 82(2)

Although facultative torpor has been observed in laboratory populations of black-tailed prairie dogs (*Cynomys ludovicianus*), it is widely believed that these animals remain normothermic throughout winter in the field. The authors monitored body temperatures (T_b) of 5 black-tailed prairie dogs in the field for about 100 days during winter and spring 1998–99. All animals entered torpor during this period. Major torpor bouts averaged 140.5 h ± 2.4 *SD* (range = 77.6–214.4) with a minimum T_b of 19.0 ± 3.6°C. Minor torpor bouts averaged 46.2 ± 20.9 h (9.5–98.5), with minimum T_b reaching 30.3 ± 2.3°C. There was no distinct relationship between ambient air temperature (T_a) and entry into torpor. All torpor bouts occurred following a sudden reduction in T_a, but not all sudden reductions in T_a induced torpor. Precipitation was not associated with entry into or arousal from torpor. The study demonstrates that facultative torpor occurs in free-ranging black-tailed prairie dogs in the field.

HERPETILES

Growth and Metamorphosis of *Bufo melanostictus* Tadpoles: Effects of Kinship and Density

S. K. Saidapur and S. Girish
J. Herpetology. 2001. 35(2)

Growth and metamorphosis of the toad *Bufo melanostictus* was studied by rearing tadpoles of different sibships in isolation or in groups of siblings and nonsiblings (mixed rearing) under crowded and uncrowded conditions. All tadpoles survived and metamorphosed successfully. Growth rate and duration of metamorphosis of tadpoles reared in isolation were similar among the six sibships regardless of genetic differences. Tadpoles reared in sibling groups metamorphosed in 25 days, whereas those reared with nonsiblings metamorphosed between days 30–35. The largest mean body mass at metamorphosis was for sibgroups reared in lower densities. When reared with siblings, growth was uniform, resulting in the production of bigger toadlets and a narrow spectrum of size classes. Mixed rearing retarded growth rates, increased larval duration, and produced smaller individuals at metamorphosis, resulting in extreme variability in size classes, especially under crowded conditions. The study shows that both kinship and density affect larval duration and size at metamorphosis in this species.

NUTRITION

Variations in Calcium Use by Birds During the Breeding Season

A. A. Dhondt and W. M. Hochachka
Condor. 2001. 103(3)

During the breeding season birds need increased amounts of dietary calcium during egg laying and nestling rearing. Passerines acquire calcium shortly before and during laying and do not store calcium for egg formation. Many passerines need to eat extraneous calcium in the form of snail shells or calcareous grit to acquire the element. However, very little is known about variation in the dependency of birds on extraneous calcium, and where this calcium is acquired. Using reports from volunteers who provided extraneous calcium sources at feeder sites across North America, the authors documented that (1) the use of extraneous calcium varied during the breeding season; (2) the location in which species preferentially took the calcium varied with typical feeding location, aside from swallows which, somewhat surprisingly, favored calcium offered on the ground; (3) brown-headed cowbirds (*Molothrus ater*) did not visit calcium sites more often than other blackbirds; (4) calcium use varied among species with thrushes, wrens, and woodpeckers taking calcium only rarely, and swallows, pigeons, and corvids taking calcium frequently. The most surprising result, perhaps, was the very high frequency of calcium use in jays; blue jays (*Cyanocitta cristata*) may hoard calcium in the fall.

JWR

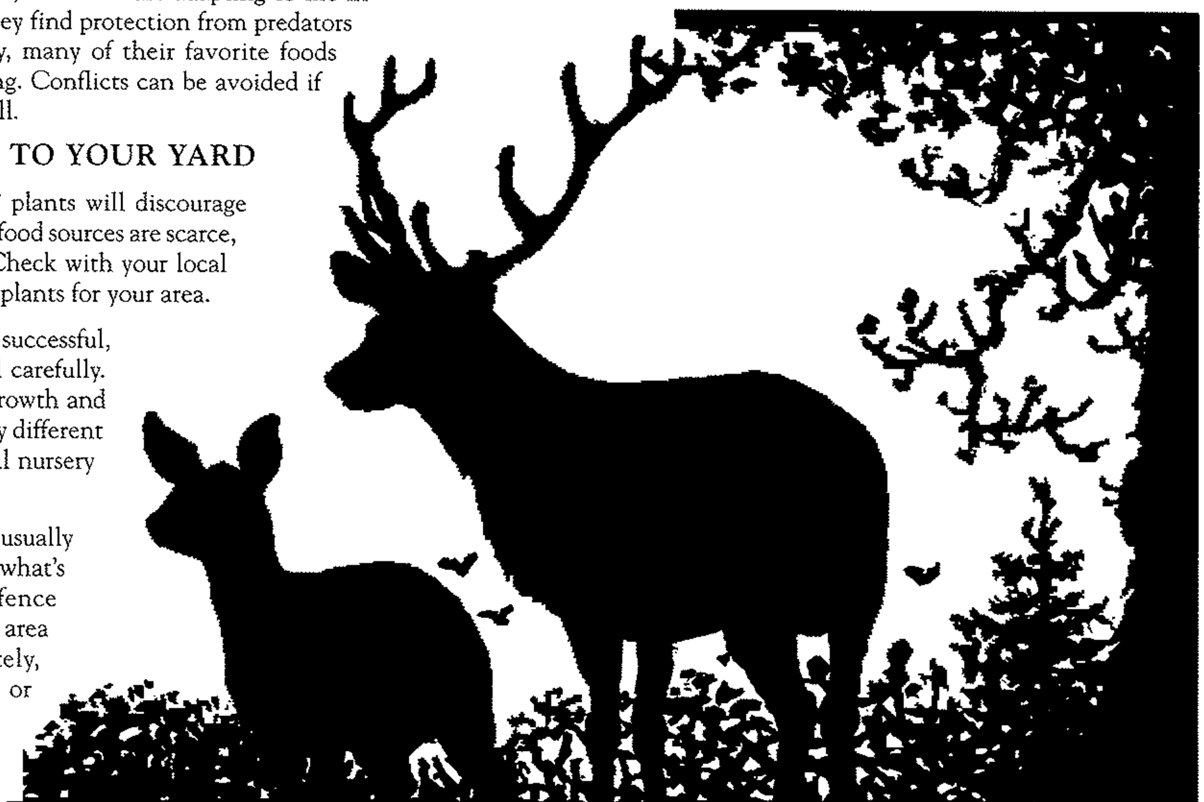
As their natural habitat disappears, wild deer are adapting to life in urban and suburban areas: here they find protection from predators and plenty to eat. Unfortunately, many of their favorite foods include plants used for landscaping. Conflicts can be avoided if humans are willing to adapt as well.

TO PREVENT DAMAGE TO YOUR YARD

Plantings: Using "deer-resistant" plants will discourage feeding in your yard, but if natural food sources are scarce, even these plants will be eaten. Check with your local nursery for a list of recommended plants for your area.

Repellents: This method can be successful, but instructions must be followed carefully. Repellents will not protect new growth and must be reapplied frequently. Many different brands are available, so ask a local nursery for recommendations.

Fencing: A solid 6-foot fence will usually keep deer out (since they can't see what's on the other side). An 8-foot fence slanted out toward the approach area will keep all deer out. Alternately, individual plants can be fenced or screened to protect them.



Living with Deer

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

Designed by WildWorks, Inc., with special thanks to Lindsay Wildlife Museum

International Wildlife Rehabilitation Council

STATEMENT OF REVENUES, EXPENSES, & CHANGES IN NET ASSETS

INCOME TAX BASIS

For the year ending December 31, 2000

	UNRESTRICTED	TEMPORARILY RESTRICTED	TOTAL
REVENUES			
Conference revenue	$ 40,023.91	$ ——	$ 40,023.91
Contributions received	2,046.11	——	2,046.11
Grants received	——	8,800.00	8,800.00
Interest income	1,587.52	——	1,587.52
Legacies and bequests	12,082.19	——	12,082.19
Literature income	18,142.15	——	18,142.15
Membership dues	70,417.00	——	70,417.00
Other income	360.46	——	360.46
Sales	125.00	——	125.00
Skills seminars	67,748.09	——	67,748.09
Satisfaction of program restrictions & expiration of time restrictions	8,800.00	(8,800.00)	——
Total Revenue	**$221,332.43**		**$221,332.43**
EXPENSES			
Accounting fees	1,036.62	——	1,036.62
Bank service charges	4,142.86	——	4,142.86
Conference costs	16,697.93	——	16,697.93
Depreciation & amortization expense	306.00	——	306.00
Employee investment option	1,500.00	——	1,500.00
Equipment rental/lease	4,675.18	——	4,675.18
Ind. contractor fees	29,400.00	——	29,400.00
Insurance	3,883.99	——	3,883.99
Office expenses	3,740.34	——	3,740.34
Other expense	236.14	——	236.14
Postage & Delivery	15,957.24	——	15,957.24
Printing & Reproduction	27,742.08	——	27,742.08
Products	824.20	——	824.20
Professional fees	711.86	——	711.86
Program expense	30,962.92	——	30,962.92
Publications	4,195.31	——	4,195.31
Rent & utilities	10,036.00	——	10,036.00
Repair & maintenance	357.50	——	357.50
Tax expense	3,845.07	——	3,845.07
Training cost	711.00	——	711.00
Wages & salaries	59,563.90	——	59,563.90
Total Expenses	**$220,526.14**	——	**$220,526.14**
Change in Net Assets	**806.29**	——	**806.29**
NET ASSETS: BEGINNING OF YEAR			
Unrestricted	44,606.99	——	44,606.99
Temporarily restricted	——	11,390.00	11,390.00
NET ASSETS: END OF YEAR	**$ 45,413.28**	**$ 11,390.00**	**$ 56,803.28**

TAIL END

by Astrid MacLeod

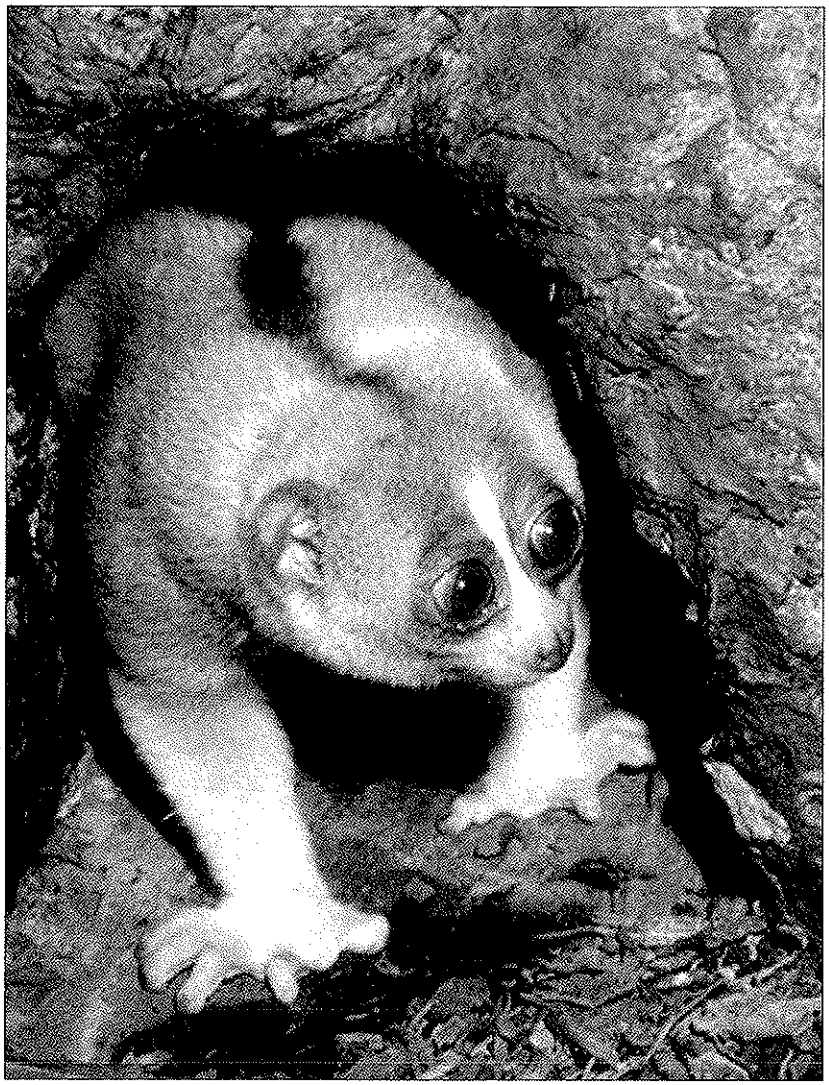


PHOTO: SLOW LORIS (*NYCTICEBUS COUCANG*) ©1997 THE LEARNING COMPANY, INC.

Have YOU seen the Maltese falcon?

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Associate editors and anonymous reviewers judge each submitted manuscript on appropriate subject matter, originality, accuracy, conciseness, clarity, and contribution to existing literature. Concurrent submission to other peer-reviewed journals may preclude publication in the *Journal of Wildlife Rehabilitation (JWR)*. All authors of each original article published receive either a $30 honorarium or a one-year individual membership or renewal. IWRC retains copyright on all original articles published in *JWR*, but will grant permission to reprint articles upon request, with credit given to IWRC.

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