INTERNATIONAL WILDLIFE REHABILITATION COUNCIL

Vol. 27, No. 1 2004

JOURNAL OF WILDLIFE REHABILITATION



IN THIS ISSUE

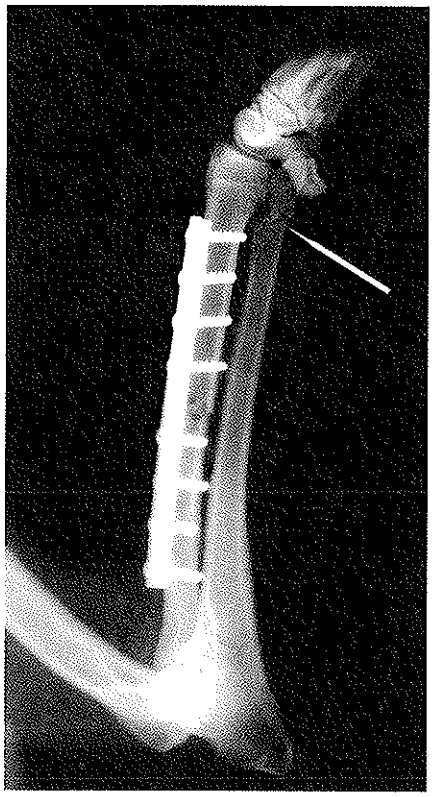
Rehabilitating rescued Chinese farm bears ... Evaluating and treating fawns with broken legs ... Vaccines and specific immunity ... Improving your patients' diets and nutrition ... *The Log from the Sea of Cortez,* a conservation classic ... The value of accurate data ... Can we understand what animals experience? ... And more

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: Rescued Chinese farm bears (*Ursus thibetanus*) enjoy the Rehab Zone enclosure at the Chengdu Asiatic Black Bear Rescue Center in Sichuan province. The center was created and is managed by the Hong Kong–based Animals Asia Foundation. See page 4. [photo: Peter J. Li]

BELOW: A closed, non-comminuted midshaft fracture of the radius (domestic dog), repaired by plate. This kind of fracture can be successfully repaired in a wild animal. See page 16. [X-ray: Robert A. Richardson]



IWRC
International Wildlife Rehabilitation Council

IWRC PUBLICATIONS COMMITTEE

Elizabeth Penn Elliston, Chair
Wildlife Rescue Inc., of New Mexico
Albuquerque, New Mexico

Susan Heckly
Lindsay Wildlife Museum
Walnut Creek, California

Kieran Lindsey
Natural Assets Consulting
Cedar Crest, New Mexico

Astrid MacLeod
Manitoba Conservation
Anola, Manitoba, Canada

Janine Perlman
Wildlife Nutrition Consultants
Alexander, Arkansas

Louise Shimmel
Cascades Raptor Center
Eugene, Oregon

FOR INFORMATION

International Wildlife
Rehabilitation Council (IWRC)
8080 Capwell Drive, Suite 240
Oakland, CA 94621
USA

510/383-9090
Fax: 510/383-9094
office@iwrc-online.org
www.iwrc-online.org

JOURNAL OF WILDLIFE REHABILITATION

CONTENTS SPRING 2004 VOL. 27, NO. 1

Editor
Marianne Skoczek
Animal Related Communications Consultants
916/488-3991

Associate Editors
Elizabeth Penn Elliston
Astrid MacLeod
Janine Perlman
Louise Shimmel

Contributing Editors
Elsa Bumstead
Kathy Dolan
Jennifer Hill
Astrid MacLeod
Janine Perlman
Mary Steuver

Veterinary Committee
Jonathan Sleeman, DVM
Chair
Lora R. Ballweber, DVM
Edward J. Gentz, DVM
Martin Haulena, DVM
Patrice Klein, DVM
Kathleen Linn, DVM
Victoria Lukasik, DVM
Tracey Neff, DVM
Helene Van Doninck, DVM

Printing
Modern Litho-Print Co.
Jefferson City, Missouri

WILDLIFE MEDICINE AND REHABILITATION

4
Rehabilitating Rescued Chinese Farm Bears (*Ursus thibetanus*): Results, Limitations, and Implications
by Peter J. Li

16
Evaluating and Treating Fawns with Broken Legs
by Robert A. Richardson and Sallie Reynolds

DEPARTMENTS

Editorial by Janine Perlman 2
Letters 3
Success Story by Louise Shimmel 22
Bugs & Drugs by Kathy Dolan 23
Food for Thought by Janine Perlman and Astrid MacLeod 26
The (Other) Value of Rehabilitators by Jennifer Hill 28
Selected Abstracts 29
Forester's Log by Mary Steuver 32
Conservation Classics by Elsa Bumstead 33
Book Reviews 34
News Briefs 38
IWRC 2003 Income & Expenses Statement 38
Ditto 39
Tail Ends by Kieran Lindsey 40

IWRC

BOARD OF DIRECTORS

President
Joe MacLeod
Anola, Manitoba, Canada

Vice President
Elizabeth Penn Elliston
Wildlife Rescue, Inc. of New Mexico
Albuquerque, New Mexico, U.S.A.

Treasurer
Dody Wyman
River Raisin Raptor Center
Manchester, Michigan, U.S.A

Secretary
Lee Thiesen-Watt
Dallas, Texas, U.S.A.

Lloyd Brown
Wildlife Rescue of Dade County
Marine Mammal Conservancy
Miami, Florida, U.S.A.

Debby Farley
Spring Brook Nature Center
Itasca, Illinois, U.S.A.

Susan Heckly
Lindsay Wildlife Museum
Danville, California, U.S.A.

Nathalie Karvonen
Toronto Wildlife Centre
Toronto, Ontario, Canada

Rob Lee
U.S. Fish and Wildlife Service (retired)
Lubbock, Texas, U.S.A.

Carlos Mclean
Fundacion Ecolombia
Medellin, Colombia

Helene Van Doninck
Cobequid Wildlife Rehabilitation Centre
Truro, Nova Scotia, Canada

Director
Jennifer Haole
Oakland, California, U.S.A.

JOURNAL OF WILDLIFE REHABILITATION

is published quarterly by the International Wildlife Rehabilitation Council, IWRC, 8080 Capwell Drive, Suite 240, Oakland, CA 94621, USA, ©2004 (ISSN: 1071-2232). All rights reserved. Permission to make duplicate copies can be obtained by contacting IWRC directly or through the Institute for Scientific Information at 3501 Market Street, Philadephia, PA 19104, USA. Articles from this publication are abstracted and cited in Focus On: Veterinary Science and Medicine, SCISEARCH, and RESEARCH ALERT.

EDITORIAL

Your Vote Matters

It's election season in the United States. This is a time when we ought to be well-informed, but many of us have spent the last months completely overwhelmed by the demands of baby season. Reading, watching, or listening to the news was a luxury that many of us simply couldn't afford.

I submit, however, that now we can't afford *not* to inform ourselves fully about the candidates and issues in the upcoming election. We can't afford *not* to make our voices heard—each and every one of us. Yes, that means ***you.*** The stakes are enormous, and the decisions that we the people make in elections will directly affect us, wildlife, and, truly, the future of the planet, in the next four years and for generations to come.

There is little question that we are losing species at a rate similar to those of previous mass extinctions caused by global catastrophes. There are hundreds of examples from which to choose.

Entire generations of seabirds—hundreds of thousands of individuals from numerous species—have been lost this year due to nesting failures in Northern latitudes. Failure to lay eggs and/or raise young was due to an absence of fish, which in turn appears to be the result of a collapse of the marine food web due to climate change.[1]

This example is dramatic and frightening, and there are many others all over the world. Rising temperatures will provide conditions in the U.S. that are evermore friendly to diseases once restricted to tropical areas. Rising sea levels threaten to inundate and destroy entire island nations.

How could the election alter our present path, on which we're careening into biological devastation? Global warming is caused by human activity—specifically, the emission of greenhouse gases—largely carbon dioxide produced by burning gasoline, coal, oil and natural gas. Find out where the candidates who want your vote stand, on this most crucial of environmental issues. (And remember that you can make a real difference with an energy-efficient vehicle, home and lifestyle.)

If the problem of rising sea levels doesn't float your boat, look around your own state, county or city. I guarantee that there are issues that will directly affect the quality of your life, and the actual possibility of life for wild animals in your area.

Here in Arkansas, for example, double-crested cormorants, a native bird, had been extirpated for decades. Recently, they began to return. One of the very first breeding colonies, located on a public lake, was slaughtered this summer because commercial interests feared that they might eventually pose a threat to private fish hatcheries at distant locations.

This act was technically legal, because federal and state officials decided to treat it as such. One state agency actually participated in the deed.

Ultimately, the agency officials who decide such matters in Washington, D.C., and in my state and yours, are largely appointed by the state and federal politicians we elect to office.

If birds don't make your heart flutter, how about endangered native mammals? The black-footed ferret relies on prairie dogs for 90% of its diet. Because of human decimation of prairie dogs, these ferrets were thought extinct in the wild, until a few were found 20 years ago. Reintroduction programs have had very limited success. The most successful colony is in the Buffalo Gap National Grassland of South Dakota. Now, because of pressure from ranchers who lease the land for grazing, the U.S. Forest Service is being forced to allow poisoning and shooting of prairie dogs in the very area that holds a fragile population of 200+ black-footed ferrets, more than all other areas combined.[2,3]

Another looming problem is that large tracts of national forests are being threatened by planned building of roads for logging. Many hunters' groups are

protesting this clear threat to the ecosystems that support game (and non-game wildlife!).[4]

Perhaps closer to home, do you know "old timers" who used to watch bright-plumaged warblers, now only a distant memory? Are there shopping centers, subdivisions, or golf courses being constructed where you used to be able to see (and release) wildlife? Habitat losses are endangering species that used to be common. Our own, our children's, and our grandchildren's ability to enjoy backyard bird song or glimpses of native mammals are likewise endangered. Your local elected officials are the people responsible for deciding whether and where local habitat is preserved or destroyed.

Voting in this election is only the beginning of our responsibilities. Afterward, it is our obligation to be (or become) informed about issues that affect the environment at all levels of geopolitics. We must regularly correspond with our elected officials. We must write letters to the newspaper and attend agency meetings. We must let our voices be heard, representing those who truly cannot speak for themselves. And we don't have much room for complaint afterward if we haven't offered our opinion where it is, literally, counted—in the ballot box.

—Janine Perlman
Wildlife Nutrition Consultants
Alexander, Arkansas

[1] *The Independent*, London. 30 July 2004.

[2] http://www.cmzoo.org/august272004.html.

[3] http://www.action.fund.org/action/index.asp?step=2&item=10179.

[4] http://www.headwatersnews.org/p.dipeso.html.

LETTERS

Rehydrating for Stayin' Alive

Dear Janine and Astrid,

It's been a busy breeding season, and it's not over yet. My youngest are two barn swallows, still in the nest!

I wanted to tell you how fantastic the rehydration formula is. (Janine Perlman and Astrid MacLeod, "Stayin' Alive, Stayin' Alive: Feeding Ill and Emaciated Birds, *Journal of Wildlife Rehabilitation*, 26(4): 8–20). They've been using it at the Schuylkill Center Wildlife Rehabilitation Clinic (Roxboro, Pennsylvania; the clinic with which I'm associated), and I'm told it makes a world of difference.

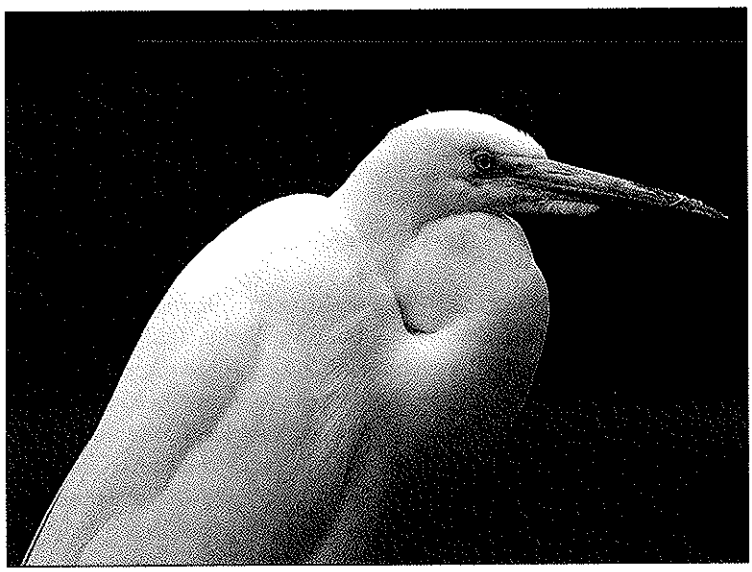
An adult yellow billed cuckoo came in thin and dehydrated—about 30% under average (Sibley). The vet who examined it found nothing, and assumed a head injury. The presenter had kept it a day and a half (was going to keep it, but when she read about its needs on the Internet, decided she couldn't provide for it). After receiving some LRS, the bird was transferred to me.

I used the rehydration and refeeding formulae from "Stayin' Alive." I followed these with slightly diluted (yes, water) MacDiet. In about a week the bird started eating on its own. I set up a private bower in a small flight, made arrangements with the John Heinz National Wildlife Preserve, and in less than 2 weeks, the bird (now 5 g over average) was released. The presenter and her family witnessed the event. Thank you, thank you, thank you!

One of the volunteers at SCWRC took the rehydration formula and reworked it into smaller amounts so that it can be made fresh each time without the waste of following the original. She then made up a kit of sorts so that all the ingredients and directions were together. She's a retired MD and always making foolproof charts, directions, etc. for the treatment lab. Now that the formula's easy to make, it's being used with very impressive results.

—Miriam Moyer
Ambler, Pennsylvania

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@earthlink.net (USPS address on the journal's inside back cover). To respond to a specific article or column, please contact the author directly. (NOTE: Letters may be edited for clarity and length.)



HTTP://PDPHOTOS.ORG

Rehabilitating Rescued Chinese Farm Bears (*Ursus thibetanus*): Results, Limitations, and Implications

by Peter J. Li

Introduction

Every year, thousands of wild animals are rescued throughout the world. Most of them are victims of a sudden catastrophic event caused by nature or human acts. In China, Asiatic black bears (*Ursus thibetanus*) are being rescued from bear farms in the province of Sichuan by the Hong Kong–based Animals Asia Foundation (AAF). The rescue efforts—the China Bear Rescue Campaign—are sanctioned by the Chinese government in response to mounting international pressures calling for the end of China's bear farming, a business operation for extracting bile from an open wound cut in the abdomen of captive bears. Unlike other rescued animals that are victims of a sudden disastrous event, Chinese farm bears are tortured daily for up to 22 years in the name of developing China's traditional medicine. Farm bear sufferings are, however, worse than what the nature could have done to them. To rehabilitate and accommodate the rescued farm bears, Animals Asia Foundation built Chengdu Asiatic Black Bear Rescue Center.

One objective of wildlife rehabilitation is the restoration of the physical and mental capacity of the rescued animals for their release to their natural habitats. Rehabilitation studies have shown mixed results based on the survival rates of animals released to the wild (Merav et al. 2002, Lander et al. 2002). Likewise, rehabilitated bears released to the wild also have different survival results (Galina 2002, McRary 2003). Rehabilitating rescued wild bears takes different forms. In one case, intimate human contact does not seem to be a problem in getting the bear cubs to exhibit ursine behaviors and to successfully adapt to a life by themselves after release (Galina 2002). Others allow little human contact to minimize imprinting, or being too dependent on humans (Gilbert et al. 1998, appbears.org 2004). The mixed results of rehabilitation underlie concerns about the efficacy and necessity of rehabilitating traumatized creatures that are not rehabilitable. Costly and less-than-effective rehabilitation of individual animals that are not in danger of extinction often invites criticism from opponents of rehabilitation (Estes 1998).

The Chengdu Rescue Center is different from most other rescue operations around the world. The rescued farm bears have problems that other rescued wildlife animals do not have. Importantly, Asiatic black bears that are farmed for their bile are listed as endangered species in Category II in the Wildlife Protection Law of China.

This article begins with an introduction to the unique conditions of the Chinese farm bears to highlight the challenges that confront the Chengdu Rescue Center. Next, the center's postrescue care program, including its components and results, is described, and the irreversible traumas the rescued bears sustain during their years of abuse on the farms are made apparent. Finally, the relevance of the experiences of the Chengdu Rescue Center to China's captive animal management, wildlife conservation, and anticruelty legislation is discussed.

Methods

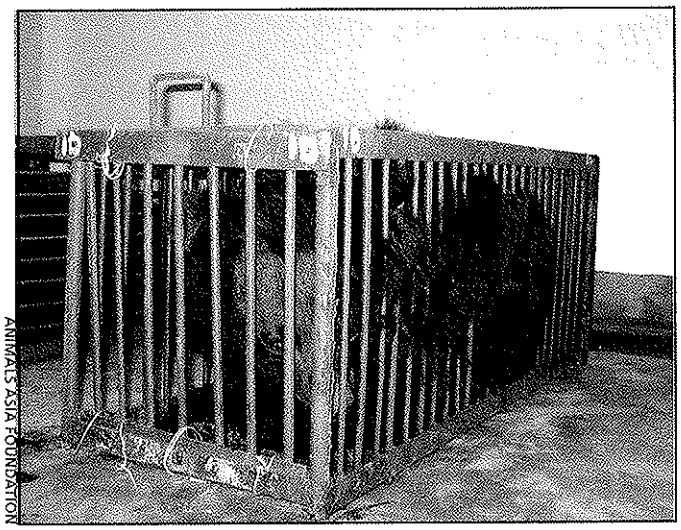
Three methods were used to collect the descriptive data in this study. First, a field study was conducted at the Chengdu Bear Rescue Center in January 2004, when the center's veterinary team was performing corrective surgeries on the recently rescued farm bears. The timing was good for observing the complex surgical procedures implemented at the center and for recording on-site the medical problems common among the farm bears. In addition, the field trip allowed me to study the center facilities, and to observe bear behaviors during and after rehabilitation. In five afternoons, I spent one hour each at the center's Rehab Zone and the permanent living quarters,

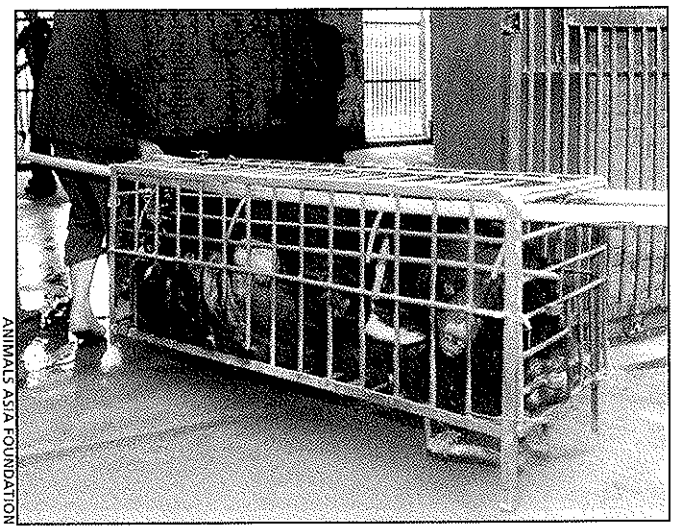
ABSTRACT: The objects of daily physical abuse and appalling deprivation for up to 22 years, rescued Chinese farm bears (*Ursus thibetanus*) pose a comprehensive challenge to the Chengdu Asiatic Black Bear Rescue Center, created and managed by the Animals Asia Foundation. This study looks at the unique conditions of the rescued bears, examines the center's rehabilitation program, and identifies the program's limitations. Despite the world-class care provided by the center and the qualitative improvement in their health, the bears have irreparable physical and mental incapacitation that undercuts their chances to survive in the wild. This situation questions the moral ground of China's bear farming and challenges its prevailing practices in captive-animal management and wildlife conservation. Importantly, the study highlights the need to accelerate anticruelty legislation on the Chinese mainland.

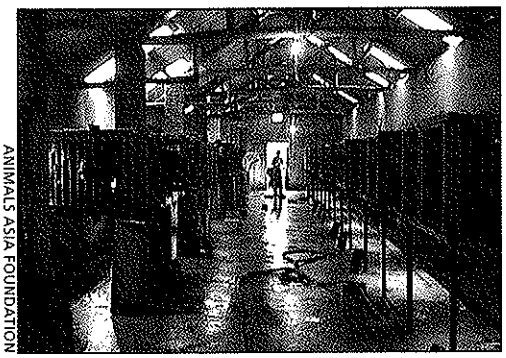
KEY WORDS: Asiatic black bear, *Ursus thibetanus*, bear farming, farm bears, bear rescue and rehabilitation, post-rescue care, Chengdu Asiatic Black Bear Rescue Center

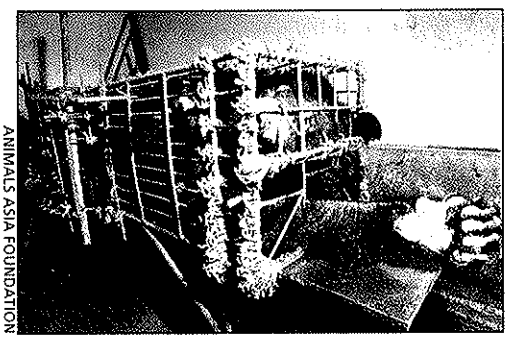
PETER J. LI, Ph.D., is an assistant professor of political science at the University of Houston–Downtown. His research interests include the "high politics" issues of foreign and military policies and "low politics" subjects such as environmental politics and animal welfare. His recent articles on China's animal policy issues include "China's Bear Farming and Long-term Solutions" (*Journal of Applied Animal Welfare Science*) and "Animal Welfare Consciousness of China's College Students: Findings and Analysis" (*China Information*, forthcoming). He is currently working on a book on China's wildlife management policy.

J. Wildlife Rehab. 27(1): 4–15
© 2004 International Wildlife Rehabilitation Council


ANIMALS ASIA FOUNDATION


ANIMALS ASIA FOUNDATION


ANIMALS ASIA FOUNDATION


ANIMALS ASIA FOUNDATION

Left: On the more than 240 Chinese bear farms, many Asiatic black bears are kept captive in tiny metal cages, too small to allow the bears to turn around in. Some of the bears have lived up to 22 years in these brutal conditions.

Above: A newly rescued bear arrives at the Chengdu Asiatic Black Bear Rescue Center.

observing bears in the enclosures. Because of my short duration at the center, and because bear behaviors during the winter can be different from those exhibited during the spring and summer, my observations were cross-verified with observations made by Claire Smith and Tim Roberts, the veterinary nurse and bear manager, who had been at the center for more than nine months.

Second, a literature review was conducted to gather information on the latest recommendations on captive-animal care. Special attention was paid to works on the physical and mental conditions of captive animals and the recommended welfare remedies for these animals. The questions I had in the course of the literature review is: How much does the Chengdu Rescue Center's postrescue care program conform to the latest recommendations of captive animal care? What are the limitations of the program, considering the level of suffering the former farm bears went through?

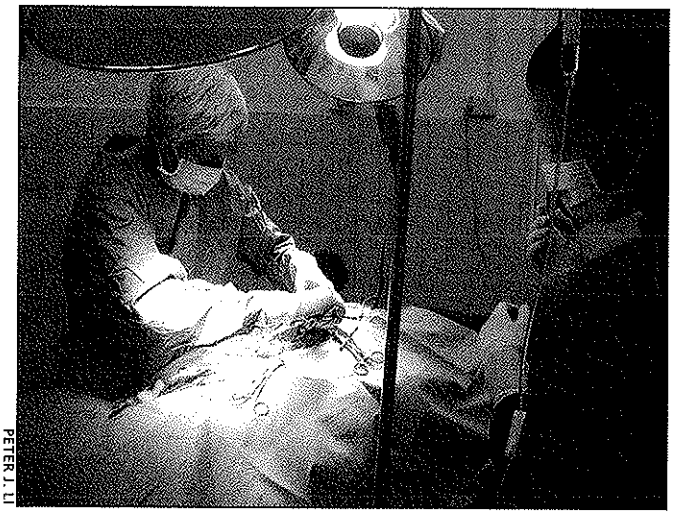
Finally, the study involves a large number of face-to-face, telephone, and electronic interviews with the center's management and veterinary teams, former owners of a closed bear farm, nongovernmental organization (NGO) activists who investigated China's zoo conditions, Chinese activists who have worked on matters related to bear farming, and Chinese officials in charge of wildlife conservation. These interviews resulted in information that supplemented the data obtained from the field study.

Conditions of Rescued Farm Bears

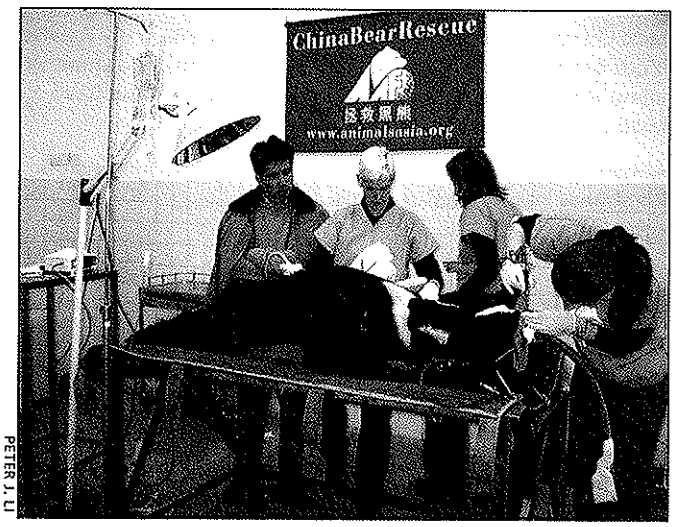
China's farm bear suffering is being recognized by more and more people throughout the world. Veterinary studies and academic discussions have detailed the extent of the physical and mental traumas of the more than 7000 bears on the farms (Robinson and Cochrane 2002; Li, P. 2004). The following brief description of the rescued bears' conditions highlights the challenges faced by the Chengdu Rescue Center.

Physical Conditions

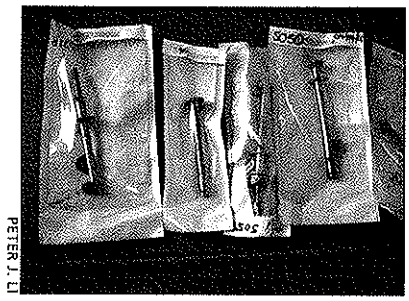
Generally, farm bears in China suffer from two acts of cruelty: deprivation and infliction. Deprivation, according to Tom Regan, author of *The Case for Animal Rights,* is defined as a harm to the animals by denying them opportunities for doing what would bring them satisfaction, whereas inflictions are harms to the animals by diminishing the quality of their life and by "detract[ing] indirectly from the individuals' overall welfare" (Regan 2003). Specific to China's farm bears, acts of deprivation include denial of proper and adequate foods, denial of free access to water, severe limitation of space, and a total denial of an enriched environment. Infliction of harm to the bears is directly associated with the techniques of bile extraction and farmers' profit-making drives. All bears undergo a crude surgical procedure, often done by untrained personnel,


PETER J. LI


PETER J. LI



PETER J. LI


PETER J. LI

Above top: Dr. Gail M. Cochrane and her staff perform corrective surgery designed to undo the phyical damage done to the bears on the bile-extraction farms.

Above bottom: A bear is preparred for surgery as the author (far left) looks on.

Right top: A damaged gallbladder with huge gallstones, removed form a former Chinese farm bear.

Right bottom: Catheters removed from former farm bears.

to insert a catheter or create an artificial fistula in the abdomen (Robinson and Cochrane 2002). The catheter or fistula is required to extract bear bile, an alleged cure-all ingredient in Chinese traditional medicine. Postsurgery infections and complications cause bears prolonged suffering and often agonizing death. Additionally, the bears suffer from farm owner-inflicted harms. For example, to make the bears easier to milk and to take away their defenses, farm owners resort to cruel practices such as chopping off the top portion of the bears' front paw fingers or sawing down to the gum level of the bears' front canine (Robinson and Cochrane 2002). Farm bears endure painful bile extraction from the open wound up to six times a day (Interview with former farm owners 2004).

The rescued farm bears have a wide range of physical problems. These include permanent incapacitation (27 of the 139 rescued bears at the center are missing limbs), damaged gallbladder, problem abscesses, peritonitis, septicemia, abdominal hernia (among 30% of rescued bears), gallstones, and gallbladder polyp formation. Foreign objects are implanted or inadvertently left behind in the abdomens of almost all the bears. Three of the center's recently rescued bears have been diagnosed with cataracts; one bear is completely blind due to years of neglect on the farm (Electronic interview with Claire Smith 2004). According to Jill Robinson, CEO and founder of the Animals Asia Foundation, and Dr. Gail M. Cochrane, AAF's veterinarian director, these problems must be addressed immediately before the bears can start the rehabilitation process.

Mental Conditions

More than half a century ago, environmental and behavioral deficits were identified as the root cause of serious mental problems among captive animals (Hediger 1950). Chinese farm bears exhibit discernible mental disorders of different degrees due to years of confinement in individual, totally barren iron cages. "Stereotyped movements were significant but limited to what could be achieved in their inadequate environment: weaving, bobbing, bouncing, rocking, and licking of the forearms" (Robinson and Cochrane 2002).

The majority of rescued farm bears, 90–95%, display significant context-free acts. Between 5–10% of the bears appear to be severely mentally disturbed. Signs of their mental disorders include psychotic self-destruction such as eating their own legs, rubbing their nose against iron bars, scraping their feet on the

floor until bleeding, and sudden, unprovoked running across the den area. Such "out-of-mind" former farm bears were also spotted as exhibits in a private zoo near Chengdu (Wedderburn 2001).

Postrescue Care Programs

The Chengdu Rescue Center is built on 19 hectares of leased land in the suburb of Chengdu, the capital of Sichuan Province. The center was designed and is operated in such a way that the welfare needs of the bears are given full consideration. Although China is not a member of the Southeast Asian Zoological Association, the Chengdu Rescue Center is perhaps the only captive-animal institution on the Chinese mainland that meets and exceeds the minimum welfare requirements suggested by the association (SEAZA 2002). The center is divided into three zones: quarantine, rehabilitation (Rehab Zone), and permanent living quarters (the Bamboo Forest). The postrescue care program implemented at the center is composed of veterinary care and an enrichment routine.

Veterinary Care

Veterinary care at the Chengdu Rescue Center has two components: corrective operation and routine veterinary service. The corrective operation is performed on all newly rescued bears that have undergone bile extraction on the farms. The routine veterinary service includes daily visual examination of bear conditions, daily monitoring of conditions of bears under medication, special care provided to mentally disturbed bears, and emergency veterinary care of sick bears. The center's veterinary team comprises a senior veterinarian and two resident veterinary nurses. The center's hospital resides in a two-storey building. It has three wards with full capacity for 12 bears. The operation room is equipped with state-of-the-art tools imported from the West. Importantly, it is maintained in strict sterile conditions, and operations are performed in compliance with the standard procedures practiced in the West.

Corrective surgery

Corrective surgery is aimed at restoring the physical health of the bears so that they are ready for physical therapy to strengthen their physique, which has been weakened by years of close confinement. Other more direct objectives include removing the damaged gallbladder and foreign objects such as catheters, metals, plastics, and sutures, and treating problem abscesses. The surgery is also used to fix the abdominal hernia problems seen among some 30% of the rescued bears. In the course of the operation, the veterinary nurses scale and polish the teeth and examine the bears' eyes. Importantly, the veterinarian uses the opportunity to check the bear's internal organs to ensure that no obvious tumor is present that was not detected by other means (such as the portable ultrasound). In two of the corrective surgeries performed in December 2003, a 5-kg liver tumor and an unusually over-sized kidney were found in two separate bears. Both bears were euthanized.

Prior to surgery, the bear is anesthetized (at about 9 a.m.), and weight and body measurements are taken. In the operating room, the bear is put on a gas anesthetics machine, which keeps the bear anesthetized and allows the operation to continue for a number of hours. A pain-killer, Torbagesic, is injected every 90 minutes. During the surgery, the heart rate, respiratory rate and blood oxygen concentrations, core body temperature, and blood pressure are measured with monitoring equipment. Manual check of heart and respiration rates is conducted every 10 minutes to guard against machine errors. Additionally, three different fluids are used through intravenous drip in the course of the operation. All surgery tools and utilities are maintained in strict sterile conditions. Before incision, the veterinarian uses the portable ultrasound to ascertain the location of the gallbladder and any abnormal growths on the liver. On average, corrective surgery of both free-dripping fistulas and catheters takes 2–4 hours, but has been known to take up to 7 hours. The number of cotton swabs used in the operation is counted before using and recounted before closing the abdomen to make sure that none are left behind in the bear's stomach. Tissue samples are collected for pathological analysis in the U.S. and the UK.

When the operation is completed, the bear is injected with a drug to partially reverse the anesthetics and allow the bear to recover faster. At the end of surgery, all bears receive an injection of pain killer that will last for 24 hours. The day after surgery they are started on oral pain-killers, which they take for the next 3–4 days. All bears are sprayed with Frontline, an insecticide solution, before returning to their wards for recovery. During the next 14–21 days the bears receive intensive care at the hospital.

Severely Stereotypic Bears

While all rescued farm bears display behaviors that are context-free and devoid of external stimulation, 5–10% of the bears are found to be severely stereotypic. When necessary, the center's veterinary team uses drugs (e.g., zuclopenthixol) to modify psychotic behavior before and after corrective surgery. As Dr. Cochrane commented to the author, the center uses both veterinary care and an enriched environment to help reduce the self-destructive behaviors. Medication is only used as a last resort.

Terminally Ill Bears

The center's veterinary team follows a humane practice that is gaining acceptance in the world of captive animal care. When an animal is terminally ill and has no prospect of recovery, euthanasia is chosen to end suffering. At the Chengdu Rescue Center, the decision to euthanize is a difficult one. At such a time, Jill Robinson is brought into the decision-making process. Together, she and the veterinary team decide the best option for the animal in question. Bears euthanized thus far had irreparable physical and mental problems, such as massive tumor formation in the liver, peritonitis, pathologically enlarged kidneys (one bear), or self-mutilation (one bear). Euthanized bears are cremated and laid to rest in a special cemetery at the center. (In contrast, terminally ill bears on the farms or those that have outlived their "usefulness" are let die without food or water, or are slaughtered for their flesh [sold as beef to unsuspecting customers], hide, gallbladder, and other parts such as bones [Interview with former farm owners 2004]).

Physical Therapy

Some form of physical therapy is implemented for most rescued animals that are injured or recovering from corrective



PETER J. LI



PETER J. LI

Top: The Rehab Zone enclosures at the Chengdu Rescue Center.

Bottom: A rehabilitated bear plays.

surgeries (Bromiley and Haussler 1999, Taylor 2004). Among the objectives of physical therapy are early resolution of inflammation, prevention or gradual elimination of muscle atrophy, and restoration of bodily functions (Taylor 2004). Physical therapy at the Chengdu Rescue Center is necessary both for the bears' full recovery from the corrective surgery and for recovery of their lost physical strength and limb functions. The rescued bears suffer from varying degrees of muscle atrophy. Some are diagnosed with arthritis, in addition to cracked (hyperkeratotic) foot pads and significantly weakened limbs due to years of confinement in the small cages.

Physical therapy takes place at the Rehab Zone, where bears recovering from corrective surgery are for the first time freed from cages. Bears begin exploring their spacious dens, taking slow and cautious steps in the first few hours after they are released from the transport cages. The Rehab Zone enclosure, complete with vertical and horizontal enrichment structures, invites the bears to use different body postures in their efforts to investigate objects, forage for food, and play with each other. Center workers use fruits or honey to lure the bears to stretch their limbs in order to reach the foods. The 3 to 6 months of physical therapy produces conspicuous results. At the time of this field study, no bears in the Rehab Zone showed any signs of physical difficulty.

Enriched Captive Animal Care

Studies in the last 20 years have stressed the importance of environmental and behavioral enrichments for captive animals. "The greater the departure of the captive environment from the natural situation, the more critical each attribute of the enclosure becomes in terms of meeting the animal's needs," states a special guideline for the care of captive nonhuman primates (IPS Captive Care and Breeding Committee 1993). As a measure to improve the captive environment, enrichment programs are receiving more attention by zoos and other institutions holding wild animals worldwide. An enriched environment is believed to encourage captive animals to exhibit natural behaviors, and such behaviors are considered good for conservation, display, and welfare purposes. One study recommends four types of enrichments that cater to the needs of different species. These include a complex environment, indestructible toys, destructible toys, and "work for food rewards" (Cocks et al. 1999).

At the Chengdu Rescue Center, structural and behavioral enrichments are implemented for the following purposes:

- Reduce boredom and under-stimulation
- Encourage the captive animals to display its normal repertoire of behaviors, namely walking, climbing, jumping, and running
- Encourage physiotherapy to restore muscle strengths and bodily flexibility
- Encourage and sustain curiosity with new objects
- Encourage individual confidence and enjoyment of life through the provision of positive reinforcements (Electronic interview with Jill Robinson 2004).

The center's enrichment program highlights space, natural and artificial structures, and a food-enrichment routine.

Space

Freedom for the bears to display their natural behaviors requires adequate space, and this was incorporated into the design of the center's bear dens and enclosures. Covered dens and open enclosures are provided in the Rehab Zone, Rupert's House, and the Bamboo Forest (permanent living quarters).

At the Rehab Zone, there are seven dens, each measuring 4 m x 4 m x 3.5m. The enclosure is 30 m x 40 m (1200 m^2). It has two perimeter fences, comprising an inner electric fence with seven strands to a height of 1.20 m and an outer chain link fence measuring 2.5 m tall with an inward-sloping 1 m metal baffle plate. Each den is equipped with four steel hammocks of different heights assigned to four bears of comparable size and temperament. Group formation is done in such a way to reduce the likelihood of weak bears being exposed to considerable risk of aggression or other types of abuse by the more dominant ones. The den floor is made of concrete for easy cleaning and drainage. In January 2004 there were 34 bears at the Rehab Zone that were out in the enclosure at different times in the morning and afternoon, for a total of 6 hours daily.

At Rupert's House, the den size is the same as those in the Rehab Zone. Rupert's House also has three dens built for

TABLE 1: COMPARISON OF SPACE PER BEAR ON THE BEAR FARM AND AT CHENGDU ASIATIC BLACK BEAR RESCUE CENTER

Average space/bear on the farm	REHAB ZONE (34 BEARS)		PERMANENT LIVING QUARTERS (FULL CAPACITY OF 48 BEARS)		RUPERT'S HOUSE (FULL CAPACITY OF 4 BEARS)	
	Den space/ bear	Enclosure space/bear	Den space/ bear	Enclosure space/bear	Den space/ bear	Enclosure space/bear
0.53 m^3*	12 m^3	33 m^2	12 m^3	112 m^2	24 m^3	72 m^2

* 0.53 m^3 is the average cage size of the 33 bears (of a total of 37) rescued and brought to the Chengdu Rescue Center in November 2003. The average size of 0.53 m^3 is barely larger than the size of the body of many farm bears.

special-needs bears. The dens back to an enclosure of 288 m^2. No electric fence is installed in this enclosure.

There are two separate zones in the Bamboo Forest, i.e., Zone 2 and Zone 3, each having a separate house with six dens. The individual dens measure 4 m x 5 m x ~3.5 m tall. Four bears are assigned to each den at the permanent living quarters. Zone 2 was home to 21 bears at the time of this study. The zone has a heavily wooded and natural enclosure of some 3,205 m^2. Zone 3 was home to 17 bears that go out to a smaller enclosure (about 2,160 m^2) on a daily basis. Both enclosures are surrounded with double fences.

In terms of space, the rescued bears are provided with a qualitatively improved environment that allows them the opportunity to assume any ursine position. Table 1 provides a comparison of their command of space at the Chengdu Rescue Center and the deprived space they had on the bear farms.

Enrichment Structures and Objects

Space alone does not equate with an enriched environment. "Size of enclosure is only of significance in terms of usable space and complexity within it...thus the quantity of space provided is less important than its quality" (IPS Captive Care and Breeding Committee 1993). Therefore, more attention should be given to the installation of enrichment structures and provision of toys to captive animals (*Laboratory Primate Newsletter* 2001, Lai and Menon 2003, Cocks et al. 1999). For example, a study on captive polar bear care recommends the provision of manipulable nonfood objects to prolong the animals' appetitive behaviors (Altman 2000).

The Chengdu Rescue Center has made noticeable efforts to enrich the environment. The center is situated in a thick bamboo forest; additionally, it has provided artificial structures and objects to the bears, as detailed in the following lists:

Artificial and constructed structures and natural objects

- A raised wooden platform (about 1.5 m from the ground) with wooden climbing frames and a hanging used rubber tire
- Vertical logs for climbing and balancing on top
- A picnic table with benches
- A sand pit
- A swimming pool and an adjacent shower
- Lawn, grown trees, bamboos, and shrubs

Destructible toys

- Straw pyramids for pulling apart
- Varieties of plant leaves such as banana leaves, sweet potato leaves, and browse
- Whole cabbages, which double as items of play and food
- Sawdust mounds

Indestructible toys

- Bamboo toys and bamboo poles with holes that allow raisins and other treats to fall out
- Hollowed-out hard plastics toys in various shapes, from football-sized to drum-sized, for containing treats
- Rubber tires, both freely on the ground and suspended by a rope for swinging on
- Rock boulders for rolling or finding insects underneath
- Kong (i.e., reinforced-rubber dog toys)

At the time of this study (January 2004), except for a swimming pool in Zone 3, artificial structures are limited in the two enclosures of the permanent living quarters. The lack of enrichment structures in the two huge enclosures is perhaps attributable to the fact that both are heavily wooded with mostly bamboos, mature trees, shrubs, and other vegetation native to the Chengdu region. And, due to the thick vegetation and mild climate throughout the year, the two enclosures are home to variety of small mammals, insects, reptiles, and birds that attract the bears' attention. According to the center's workers, bears engage in different ursine behaviors in the enclosure, and some of them enjoy breaking the bamboos at mid-length. Bears are also spotted eating small mammals (Electronic interview with Claire Smith, 7 May 2004). Both destructible and indestructible toys are provided and rotated at the permanent living quarters.

As Jill Robinson disclosed in August 2004, enrichment structures have already been added to these two enclosures.

"Working for Food" Reward

Food enrichment has two inseparable elements: varieties of food and methods of delivery. Animals in the wild spend large amounts of their waking hours searching for food. Studies suggest that monkeys spend up to 40% of their time feeding; giant pandas spend more than 80% of their time searching for tender bamboo leaves and eating. In contrast, animals in captivity are generally fed large amounts that are easily accessible. They are, therefore, left with large periods of time feeling bored in the often-barren environment. At the Chengdu Rescue Center, a food-enrichment program is implemented at the Rehab Zone and the Bamboo Forest. A food-enrichment calendar details the varieties of food, times of provision, and methods of delivery for each day.

The center provides the bears with a cereal-based bear meal ordered from a local poultry food processing plant. The meal, made in strict compliance with AAF's requirements, contains rich vitamins and mineral elements. Boiled egg is provided to bears in the Quarantine Zone and in the hospital. Varieties of fresh fruits, nuts, dried fruits, and vegetables are also served with the two major meals each day and in three daily snack times. In addition, fruit juice, Tang, yoghurt, canned fruits, fish paste, peanut butter, honey, cooked and flavored rice, and other foods are provided. Importantly, food is provided multiple times and in smaller amounts. The menu at the Chengdu Rescue Center is a huge contrast to the bear diet on the farms. As my interview with the former owners of a closed bear farm confirmed, farm bears are generally fed a vitamin-poor corn mash twice a day. Although seasonal vegetables and a variety of fruits and nuts are readily available in Sichuan throughout the year, farm owners deny these varieties to the bears. "They cannot be fed too well," the former farm owners said. "Well-fed bears do not produce enough bile because it is used to digest good food" (Interview with the former farm owners 2004).



PETER J. LI

Rescued bears in the permanent housing facility following rehabilitation.

At the center, different methods are used to deliver food to the bears in an attempt to prolong the feeding time, stimulate the bears' senses, encourage the use of different feeding pos-

TABLE 2: FOOD ENRICHMENT CALENDAR (3-DAY COMPARISON) AT THE CHENGDU ASIATIC BLACK BEAR RESCUE CENTER

1st day of month	2nd day of month	3rd day of month
IN THE BEAR DENS:	**IN THE BEAR DENS:**	**IN THE BEAR DENS:**
10:15 a.m. — banana palm	10:15 a.m. — treat tubes	10:15 a.m. — box treats: cereal
11:30 a.m. — bamboo treats, fruit	11:30 a.m. — Kongs, vegetables	11:30 a.m. — lotus roots
2:15 p.m. — iceblocks	2:15 p.m. — sugar cane	2:15 p.m. — log treats, cartons
4:00 p.m. — box treats, vegetables	4:00 p.m. — iceblocks	4:00 p.m. — pumpkin
5:30 p.m. — bamboo branches	5:30 p.m. — nu zhen (a local plant)	5:30 p.m. — willow branches
IN THE ENCLOSURE:	**IN THE ENCLOSURE:**	**IN THE ENCLOSURE:**
9:30 a.m. — scatter nuts/seeds mix, rice, place box treats, oil spray, banana palm	9:30 a.m. — dried leaves (piles), herbs/spices, scatter fruit/ vegetables, sugar cane	9:30 a.m. — tree stumps, toys, wood shavings, lotus roots, rice, melon
3:15 p.m. — bamboo branches, cereal, melon, pumpkin pieces	3:15 p.m. — bear toys, dried fruit nu zhen, treat tubes, yoghurt drizzles	3:15 p.m. — smears, scatter nuts/ seeds, willow branches, scatter fruit/vegetables, oil spray

tures (digging, standing, and stretching to reach food hanging overhead or hidden underneath), and engage them in environmentally directed behaviors. For example, meals are scattered in the dens or in the enclosure. Nuts, dried fruits, and seeds are placed in bamboo trunks, tubes, small wood logs, or carton boxes. Pieces of fruit are hidden under the bushes and logs, in the raised wooden platform, or in a stack of dry hay. Ice-blocks made of fruit juices and Tang, or frozen with seasonal vegetables and fresh fruits are provided. Center workers use syringes to inject yoghurt on different surfaces such as logs, ground, holes, walls, and baskets. Honey, peanut butter, jam, fish paste, and other liquid foods are thinly spread on vegetables and a range of other surfaces at different levels. Essential oils diluted in water are sprayed around the enclosure or in the den to stimulate the bears' senses. Locally grown seasonal herbs are also used for this purpose; for example, fresh garlic is rubbed on the wall or logs to engage the bears in intensive sniffing games (Electronic interview with Jill Robinson 2004).

Results and Limitations

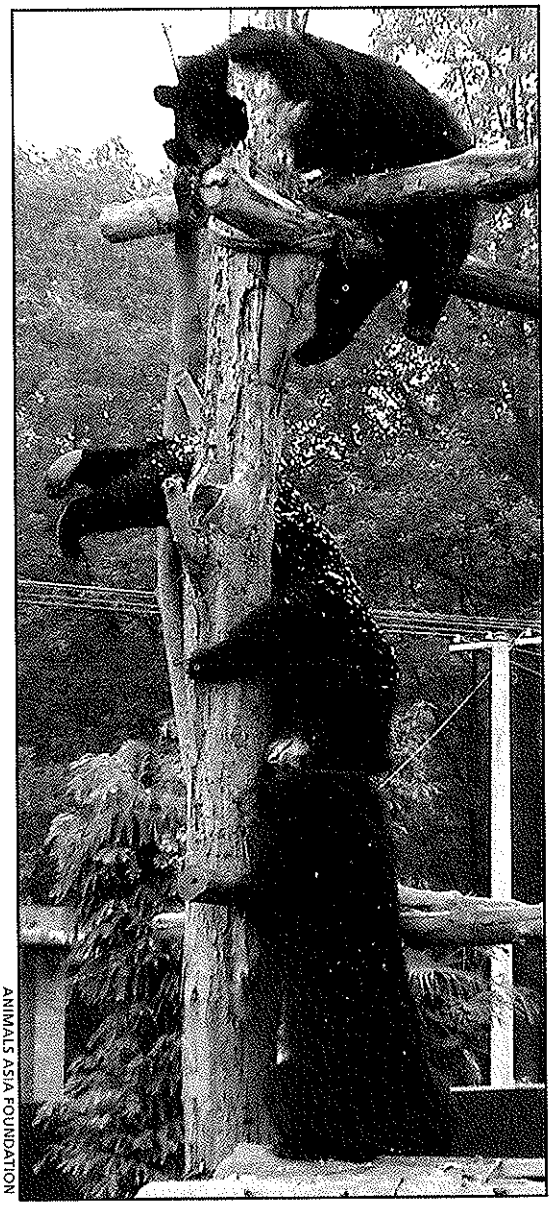
The Chengdu Rescue Center improves the physical and mental conditions of rescued farm-bears so that they can live the remainder of their lives in a deprivation- and infliction-free environment. The center is a permanent sanctuary and, as such, it has never sought to return the rehabilitated bears to the wild. To evaluate the effectiveness of the center's postrescue care, we need to refer to the objective of its care programs.

Physical Health Improvements

Since the center opened in 2000, it has accepted 139 bears. At the time of this study, 116 bears were in its care. Of the 85 bears that had undergone corrective surgery by the end of 2002, 82 bears—more than 95%—survived for more than a year. This is an impressive survival rate compared with the reported 20%–40% death rate on the farm in the first year of bile extraction.

My observation of the bears in the Rehab Zone and the permanent living quarters (i.e., bears have been at the center 3 months–3 years) confirmed the noticeable improvement of the bears' physical conditions. I based my observation on factors such as agility of movement, qualities of bear hair, level of activity, degree of socialization, and bear size. The bears in both locations are active, explorative, and move with no observable difficulties. While observations made over the course of just 6 days may not be accurate, the center's veterinary team confirmed that the bears are in good health.

Weight gain or loss within a specific period of time can be an indicator of improved or declining health. As Dr. Cochrane commented, sudden weight loss as a result of behavioral change and appetite loss often indicates the existence of severe health problems. Books on farming bears concur that behavioral change and appetite loss are symptoms of illness such as pneumonia, diarrhea, and parasites in the bear's body (Zhang 2001). While there are no weight data on the bears after their corrective surgery if afterwards they have had no reason to receive medical attention, bear weight is monitored visually by the veterinary nurses and the bear keepers. Weight loss was reported on a small number of bears. Those with drastic weight loss over a short period of time are usually moved into the hospital for emergence



ANIMALS ASIA FOUNDATION

Rehabilitated bears play in the Rehab Zone enclosure.

veterinary attention. For example, Bear 6 was reportedly unusually lethargic, getting up late in the morning, not returning to den for a few nights, having no appetite, and decreasing in body weight. Veterinary examination confirmed that the bear was suffering from a tumor (about 1 kg) at the liver area.

At the time of this study, all 42 bears at the Rehab Zone and 36 bears (except Bear 6, who was euthanized due to the liver tumor) at the Bamboo Forest, were in good health, as judged by their behaviors, appetite, and appearances. Even though 19 bears at the Rehab Zone were permanently handicapped by their past injuries and moved with difficulty, they looked normal and displayed behaviors that their handicapped conditions allowed them to. The results of the corrective surgery were impressive. "By removing the damaged gallbladder, foreign objects, and the abscesses that could cause problems, and fixing the abdominal hernia problem, we are almost sure that these bears after the surgery will live a pain-free life," commented Dr. Cochrane. The bears' thick and shinning fur

TABLE 3: LIST OF BEHAVIORS OF BEARS AT THE REHAB ZONE AND BAMBOO FOREST (BASED ON A TOTAL OF 12 HOURS' OBSERVATION IN JANUARY 2004)

BEHAVIORS	REHAB ENCLOSURE	BAMBOO FOREST	COMMENTS
Foraging for food	Yes	Yes	———
Eating	Yes	Yes	———
Investigating objects	Yes	Yes	———
Playing and chasing (mounting) each other	Yes	Yes	———
Playing with toys	Yes	Yes	———
Tree climbing	No	Yes	———
Tree breaking	No	No	———
Bathing in the sun and napping	Yes	Yes	———
Context-free weaving	No	Yes (one bear)	Bear 19 was weaving outside his closed den door on two aftenoons
Self-mutilation	No	No	———

and their level of activities even during winter suggest general good health.

Reduction of Context-Free Behaviors

Stereotype behaviors are detectable in all farm bears. Yet, according to Dr. Cochrane, context-free behaviors such as weaving disappear among 90% of the bears in the Rehab Zone and the Bamboo Forest. Yet, moderately stereotype behaviors are still seen among 5%–10% of the bears at the center, most often before meal time or when they want to get out to the enclosure or get in their dens. My observation of the bears in these enclosures confirms Dr. Cochrane's observation. I did not witness any stereotype behaviors at the Rehab Zone. Bears spent most of their time in the enclosure foraging for food, playing with toys, and chasing each other; on 3 days, one bear attempted to mount another. Other behaviors included exploring objects and lying on the raised platforms or on the grass taking a nap.

At the Bamboo Forest, the thick vegetation makes observation difficult. Although I could only see about 10 bears that stayed close to the fence in each of the forest's two zones, I did observe, on 2 separate days, one bear weaving outside a closed den door. The weaving lasted the entire 1-hour period of my observation. Apparently, this bear wanted to get back to its den before it was supposed to. During this study, Bears 19 and 30 were reported as exhibiting stereotype behaviors at the center's weekly staff meeting. Bear 19 was spotted pacing near the electric fence, and Bear 30 was pacing next to the food on the enclosure ground. Half of the bears in the Bamboo Forest disappear in the thick bamboos that cover about 85% of the enclosures. Some can be found making comfortable nests under the lush bamboo branches. Many enjoy breaking bamboos at mid-length. I did not observe bears doing this, however, I did notice areas of the forests where the bamboo had been impacted by bear activities. As in the Rehab enclosure, most bears I could watch were exploring and investigating objects. One bear was particularly fond of a rubber ball and played with it in a variety of positions.

It should be noted that, during the time of this study (i.e., winter), bears in both enclosures did not appear bored. According to a center worker, the bears are relatively more active during the spring and summer, when varieties of wild plants and assorted insects, reptiles, and small mammals attract their attention. Table 3 lists observed behaviors in the Rehab Zone and the Bamboo Forest.

Jill Robinson, who spends one-third of her time each year at the Chengdu Rescue Center, summarized her observations of bear behaviors in the enclosure as follows:

> ...I notice that there is voracious feeding for most, if not all of them for the first 20–30 minutes. During this time, there is frantic running around, snatching the most obvious food they see and find, "warning" vocalizations to other bears, and occasional "mouthing," which generally only results in the less dominant

bear giving in and scuttling away. This behavior reduces as they all become more sated. At this time many then go into foraging mode for perhaps another 20 minutes or so, passing up the food they don't really like and becoming more selective. Finally, they will move into a grazing pattern (i.e., of grass as they lie down), and opportunist feeding (i.e. if they see or smell something they originally missed!) for the rest of the morning or afternoon, interspersed with play and sleep. At this stage we often see them playing with some of the food that wasn't their favorite—cabbage leaves for example. The enrichment toys double up, both providing a tasty treat when filled with nuts and dried fruit and becoming something to lie back and play with. The toys work well in keeping them occupied and amused for varying degrees of time. Every now and then, they might get lucky too—with the odd raisin falling out! (Conversation with Jill Robinson 2004).

Two of the severely mentally disturbed bears that arrived with the group in November 2003 have been given zuclopenthixol to control their behavior. Dr. Cochrane was concerned about the stressful effects of moving the bears between quarantine and hospital and subsequent abdominal surgery, and that the bears would possibly develop a pattern of self-mutilation. The drug so far has proven to decrease the anxiety of these bears and no self-mutilation has been observed. The bears have calmed down and are behaving in a more normal manner appropriate for their surroundings. Generally, when bears are moved to the Rehab Zone, their context-free behaviors are significantly reduced as a result of socialization, enrichments, and space of movement, but can sometimes persist in a small number of bears (fewer than 10%).

Limitations

The foregoing discussion shows that rescued Chinese farm bears are a special group of wild animals. Physically, mentally, and from a moral standpoint, they are not eligible for returning to the wild. When bears arrive at the Chengdu Rescue Center, they are frightened, aggressive, and clearly afraid of people. Following intensive nursing care in the pain-free new environment, the bears become more relaxed through association of kind treatment from people. Ultimately, most are not afraid of people. They seem to care very little whether they are being watched or not.

Despite world-class veterinary care, the damage caused by the crude surgery procedures performed on the farms cannot be corrected among a small number of bears. One bear named Max was found to have peritonitis at the time of the corrective surgery, and he was put on treatment for the illness. Subsequent blood tests showed results within the normal bear range. However, 6 months after the surgery, Max was noted with a decrease in appetite and with significant behavioral change. He was taken into the hospital for exploratory surgery, where it was found that the peritonitis had returned. It was apparent that the original peritonitis could not be completely eliminated, and Max was euthanized. Regarding another bear, Sam, no peritonitis was observed during the corrective surgery. But, 2.5 years later, he was seen with decreasing weight, loss of appetite, and behavioral changes. At the exploratory surgery, Sam was diagnosed with peritonitis involving the mesentery, and he had to be euthanized.

The center's management and staff found that some bears in the permanent living quarters want to return to their dens before they are called in by bells. This phenomenon needs further study to determine whether the bears come inside because it's shady and cool, and often gives them a sense of security. It is clear, however, that the bears are not rejecting the concrete dens. Years of confinement on the farm may have accustomed the bears with life in artificial settings such as the dens. China's farm bears come from two sources: breeding farms and wildlife traders who catch bears in the wild. The artificially farmed bears grow up in concrete dens and concrete enclosures. They are bred as bile bears and have no past connections with bears' wild habitats. Many of those caught in the wild as young bears have also become used to the barren environment of the bear farms. Additionally, many of the captured wild bears have either lost the physical fitness with missing limbs or forgotten the skills needed for survival in the wild. No enrichment program, however complete, can reverse the bears' physical traumas.

Despite the conscientious efforts at the Chengdu Rescue Center to provide an enriched environment for the bears, stereotype behaviors persist among 10% of the bears. A very small number of the bears display moderate to serious context-free behaviors. That some bears continue to act abnormally in the natural enclosure of the Bamboo Forest suggests that no enrichment program could eradicate acts caused by mental disorder.

Morally, the rescued bears cannot be returned to the wild for two other reasons. China's bear farming continues in the province of Sichuan and elsewhere. Released bears could easily fall victim to poachers who profit from illegal bear capture and sale to bear farms. Further, human activities impact even the most remote areas of the country. Like American black bears (*Ursus americanus*), Asiatic black bears need a big home range to forage for food. The fragmentation of even the giant panda reserves is indicative of the fragmented mountainous ranges bears call home. Their survival in the wild can be a comprehensive challenge.

Management, Conservation, and Policy Implications

The Chengdu Asiatic Black Bear Rescue Center is the antithesis of most captive-animal institutions in China. With its spacious bear dens, enclosures, world-class veterinary care, happy bears, and clean and sanitary conditions, the center commands respect. Its experiences in rehabilitating rescued farm bears should serve as a catalyst for a radical change in China's captive-animal management, wildlife conservation practices, and policies regarding animal protection.

China's captive-animal management is considered half a century behind the world humane development (Electronic interview with Merritt Clifton, chief editor of *Animal People*, 20 January 2004). Many of China's animal-holding institutions have been described as a "typical miserable hellhole," "a matter of shame for China," "world's worst zoos," and "another miserable tribute to human's inhumanity" (Wedderburn 2004). Most mainland Chinese zoos offer their animals no enrichment, and visitors never fail to see "rows and rows of identical menagerie-style concrete and iron cages housing miserable zoochotic



PETER J. LI

Bears foraging for food in the Rehab Zone enclosure.

animals" (Wedderburn 2004). Not only are animals dying of severe food deprivation, some facilities encourage visitors to engage in cruel acts such as live feeding and using live animals as shooting targets. As Dr. John Wedderburn, a Hong Kong–based animal rights researcher and advocate, observed in the zoos he visited, "practically every visitor shouted and banged to watch the fright reaction" from the animals. In one of my own visit to a zoo in southeast China's Nanchang City, I was shocked to see an army solider spit at a giant panda frantically pacing in an extremely small and totally barren pit enclosure. Isn't poor management of the zoos partially responsible for the uncivilized acts among the visitors?

The Chengdu Rescue Center's experience demonstrates the limitations of any postrescue care to imprinted wild animals. While most bears enjoy their newfound freedom in the natural enclosures of the center's Bamboo Forest, a small number are observed to return to their dens earlier than they are supposed to. Apparently, the artificial structures are not unacceptable to them due to years of close contact with humans and human environment. What does this behavior suggest to the many so-called conservation projects involved in wildlife breeding, for example, Siberian tigers in China? How can these projects succeed in their goals of eventually returning the animals to their natural habitats, if these animals are used as "exhibits" and at the same time have daily contact not only with their keepers but visitors who live feed them?

The Chengdu Rescue Center is managed according to the latest welfare recommendations being implemented by animal institutions in many countries. In contrast, most of mainland China's captive-animal institutions lack such standards. Many of China's private zoos are not members of the Chinese Zoological Association (CZA), a government organization for guiding zoological gardens. Regrettably, CZA has shown no interest in joining the Southeast Asian Zoological Association (SEAZA), which seeks to improve captive-animal care throughout the region (Pers. comm. with Dr. G. Agoramoorthy, one of the chief architects of SEAZA).

This situation indicates that the Chinese government is not yet prepared to introduce the international standards for captive-animal care. Yet the bears at the Chengdu Rescue Center bear testimony to the need for the Chinese authorities to change the country's animal welfare policies. According to the Wildlife Protection Law passed in 1988, Asiatic black bears are a state-protected species. However, the law only provides protection to bears in the wild; it does not cover bears on the breeding farms and those used in the bile-extraction business. While the law penalizes acts that result in the death of state-protected species in the wild, it contains no articles against acts of cruelty against these animals. Cruelty inflicted upon the farm bears had long been ignored by the farm owners and local officials because it is not punishable under existing law. Chinese legal experts and animal advocates have worked hard to get the government to revise the Wildlife Protection Law so that it will also cover wild animals in captivity (Wu 2003; Li, X. X., 2003) and include anticruelty articles.

Regrettably, there are currently no signs to suggest that the Chinese government is ready to adopt a comprehensive animal welfare law, which would have an adverse impact on the many profit-making businesses dealing in wild or domesticated animals, and which would be difficult to enforce in a country where cruelty to animals is so widespread. However, separate welfare legislations on animals in different roles (e.g., entertainment, testing, working) should not be ruled out.

Conclusions

No rescue efforts can achieve the release of the more than 7000 bears still behind bars in the more than 240 bear farms in Sichuan and other provinces across the Chinese mainland. The Chengdu Asiatic Black Bear Rescue Center and the China Bear Rescue Campaign have, however, provided some hope. While the center has brought into the heartland of the Chinese mainland new concepts, standards, and practices of captive-animal care, its influence reaches much further.

First, it directly challenges the fundamentals of bear farming. The rescued bears at the center are testimony to the intrinsic cruelty of the farming operation. Bear farming is not an "improvable" operation, as the center's rehabilitation records have shown. "Empty cages, not larger cages" is the only solution to the farm bears' plight. The financial resources needed to rescue all 7000 farm bears are staggering, as is the level of resistance that would be encountered.

Second, the Chengdu Rescue Center offers an alternative management model for China's captive-animal institutions. It emphasizes the importance of adopting the world's latest welfare recommendations for animal care, providing animals in captivity a decent environment, and catering to their health and mental needs. Instituting a respectful captive-animal environment not only serves the welfare of the animals, it also fosters decency and respect among the humans in frequent or occasional contact with the animals. China is making great strides economically. However, modernization cannot be singularly defined as economic growth and the accumulation of wealth. A modern society cannot be a hell hole for its nonhuman animals.

Finally, as the antithesis of most other Chinese captive animal holding institutions, the Chengdu Rescue Center stands for a radical change in the Chinese official position on animal welfare. The persistence of the bear farming operation and the level of suffering on the bear farms are results of the lack of

an anti-cruelty law on the Chinese mainland, a policy area that is more than 180 years behind world humane progress. Admittedly, what the center faces is not only the passivity of the Chinese government on the issue of animal welfare legislation. It is operating in a country that is yet to redefine the relations between humans and other animals. Regardless of the challenge, the Chengdu Rescue Center is making an impact in its own way.

Acknowledgement

The author wishes to thank the two anonymous reviewers for their comments and suggestions on improving the early version of the manuscript. His sincere thanks also go to Jill Robinson, CEO and founder of Animals Asia Foundation (AAF), Dr. Gail M. Cochrane, AAF's veterinary director, Chengdu Rescue Center management team members Boris Chiao, Christie Yang, and Claire Smith, and Tim Roberts for their assistance and generous provision of information during his field study and afterwards.

References

Altman, J. D. 2000. Effects of inedible, manipulable objects on captive bears. *J. Applied Animal Welfare Sci.* 2(2): 12332.

Appbears.org. 2004. How to rehabilitate bears for returning to the wild. http://www.appbears.org/how_abc_works.htm (19 April 2004).

Bromiley, M. W., and K. K. Haussler. 1999. Physical therapy for the equine back. Back problems. Veterinary Clinics of North America. *Equine Practice* 15(1): 223–46.

Cocks, L., C. Baker., G. Harris, and F. Butcher, F. 1999. Behavioral enrichment for nonhuman primates. *Lab. Primate Newsl.* 38(1 [January]). http://cgi-user.brown.edu/Research/Primate/lpn38-1.html#perth (6 April 2004).

Laboratory Primate Newsletter. 2001. Enrichment discussion: The sugar question. *Lab. Primate Newsl.* 40(3 [July]). http://cgi-user.brown.edu/Research/Primate/pn40-3.html#sugar (6 April 2004).

Estes, J A. 1998. Concerns about rehabilitation of oiled wildlife. *Cons. Bio.* 12(October): 1156–57.

Galina, E. 2002. Bear Necessities. *People* 58(4): 89–90.

Gilbert, B., and B. Ballenberg. 1998. The joys of rehabilitating. *Smithsonian* 28(February): 60–68.

Hediger, H. 1950. *Wild animals in captivity.* London: Butterworths Science.

IPS Captive Care and Breeding Committee. 1993. IPS International Guidelines for the Acquisition, Care and Breeding of Nonhuman Primates: Codes of Practice 13. *Primate Report*, Vol. 35. http://velnet.wustl.edu/species/primates/primguid.txt (6 April 2004).

Lai, C. H., and C. S. Menon. 2003. Animal welfare through environmental and behavioral enrichment. Paper delivered at the Southeast Asia Zoological Association. http://www.seaza.org/Conference/7th_conference/scientific_papers/animal_welfare_through_environme.htm (6 April 2004).

Lander, M., J. T. Harvey, K. D. Hanni, and L. E. Morgan. 2002. Behavior, movements, and apparent survival of rehabilitated and free-ranging harbor seal pups. *J. Wildlife Mgmt.* 66(1): 16–28.

Li, P. 2004. China's bear farming and long-term solutions. *J. Applied Animal Welfare Sci.* 7(1): 71–80.

Li, X. X. 2003. A proposal on the need to legislate on animal welfare. Legislative proposal submitted to the National People's Congress, unpublished copy provided by X. X. Li.

Martin, S. 1997. Training: A critical component of enrichment programs. Speech delivered at the American Zoo Association national conference. http://www.naturalencounters.com/aza2.html (19 April 2004).

McRary. A. 2003. Barely a bear. http://www.appbears.org/ursula.html (20 May 2004).

Merav, B., G. M. Blundell, and J. E. Blake. 2002. Post-release survival of river otters: Effects of exposure to crude oil and captivity. *J. Wildlife Mgmt.* 66(October): 1208–23.

Robinson, J., and G. M. Cochrane. 2002. Veterinary and welfare discussions of bear farming and bile extraction methods. An Animals Asia Foundation report. http://www.animalsasia.org/beinformed/images/AAF_vetReport.pdf (August 2003)

Regan, T. 2003. The case for animal rights. In *The animal ethics reader,* edited by S. J. Armstrong and R. G. Botzler. London: Routledge.

SEAZA (Southeast Asian Zoological Association). 2002. Animal welfare minimum standards of Southeast Asian Zoological Association. http://www.seaza.org/welfare_chair/welfare)_index.htm> (29 May 2004).

Taylor, R. 2004. Physical therapy in veterinary medicine. http://www.vin.com/VINDBPub/SearchPub/SearchPB/Proceedings/PR0500/PR00205.htm (1 March 2004).

Wedderburn, J. 2004. Sichuan zoos and markets. http://www.aapn.org/sichuan2001.html (6 June 2004)

Wu, TY. 2004. Is it "too early" or "too late" to legislate on animal welfare? Legislative proposal submitted to the National People's Congress, unpublished copy provided by T. Y. Wu.

Zhang, H. Z. 2001. *The farming and processing of wild animals for medicinal use.* Beijing: Jintung Publishing House.

To Contact the Author

Peter J. Li, Ph.D.
Assistant Professor of Political Science
Social Sciences Department
University of Houston-Downtown
One Main Street
Houston, Texas 77002
USA
Tel: 713/221-2741
E-mail: lipj@uhd.edu

Evaluating and Treating Fawns With Broken Legs

by Robert A. Richardson and Sallie Reynolds

Introduction

Can we save any fawn with a broken leg?

Many wildlife agencies recommend euthanizing all such fawns, reasoning that with traditional splints, casts, and pins, the repair will probably not be strong enough to sustain the high-impact activities of leaping and "stotting" (the four-legged springing common in mule deer [*Odocoilus hemionus*] and black-tail deer [*O. hemionus*, subspecies]). Furthermore, bones are expensive to fix under the best circumstances, and preventing re-injury is difficult. Still, those of us who work with wild animals, rehabilitator and veterinarian alike, want to give each individual a chance at a successful life in the wild whenever possible.

Fortunately, we *can* treat some fawns with broken legs with a reasonable expectation of a life-long repair. The key to success lies both in science—an accurate assessment of the kind and location of the break and the best treatment and follow-up—and in a more tenuous factor: how the individual fawn reacts to the stress of the injury and subsequent handling.

The best evaluation of a fawn depends upon the combined experiences and skills of the rehabilitator and the orthopedic veterinary surgeon, who together can give the animal the most knowledgeable consideration and care.

Method

Author Reynolds had observed that injured fawns brought to Sierra Wildlife Rescue (Placerville, California) whose legs had been set with casts, pins, and splints did not seem as strong in their activities as fawns that had not suffered a broken leg. Concerned that they had been released inappropriately, she asked author Richardson, a veterinary orthopedic surgeon who has considerable expertise with bone injuries in domestic animals, if he could recommend a treatment that would provide a stronger, long-term repair. Author Richardson responded that surgical repair—internal fixation—of a long-bone break was the best option.

Given a wild fawn in general good health, two potential problems with internal fixation are the possibility of infection of the wound and later osteomyelitis, and the animal's early, too-vigorous post-operative activity, which could destroy the "fix" before bone healing can advance. Domestic animals recovering from such surgery are put on a regimen in which activity levels are increased slowly, a practice quite difficult to orchestrate with wild patients. And while domestic animals can be given long-term antibiotic treatment or undergo a second operation if infections or other problems arise, these are not good options with wild animals because of stress and release factors.

With these difficulties in mind, the authors developed criteria for a good prognosis, using information from both rehabilitation and surgical fields. They summarized their efforts into two goals that, if achieved, could give the right animal a reasonable chance of release: long-term successful repair of the break, and minimal stress. This paper defines the criteria for attaining these goals.

Osteosynthesis: Balancing Opposing Forces

Osteosynthesis, or bone healing, starts at the moment of injury. Many factors contribute to the process, but it is essentially a balance of *osteoblastic* and *osteoclastic* activities. An osteoblast is a cell that makes bone. An osteoclast is a cell that dissolves bone, normally allowing blood vessels and nerves to re-enter a fracture site. The equilibrium between construction and destruction can be disrupted, most notably by excessive motion at the site, infection, and inadequate nutrition, any of which may allow osteoclastic activity to prevail.

ABSTRACT: The authors discuss the criteria for evaluating and treating broken leg bones in wild fawns, recommending a working partnership between rehabilitator and veterinary surgeon. Their goals: (1) to provide the deer with a life-long repair that will hold up under normal adult activity; and (2) to minimize the stress of handling. This means providing a surgical repair; administering anesthesia once only; preventing infection without undue handling; and overseeing the animal's activity levels, returning it to normal activity in a rehabilitation "herd" at the proper time.

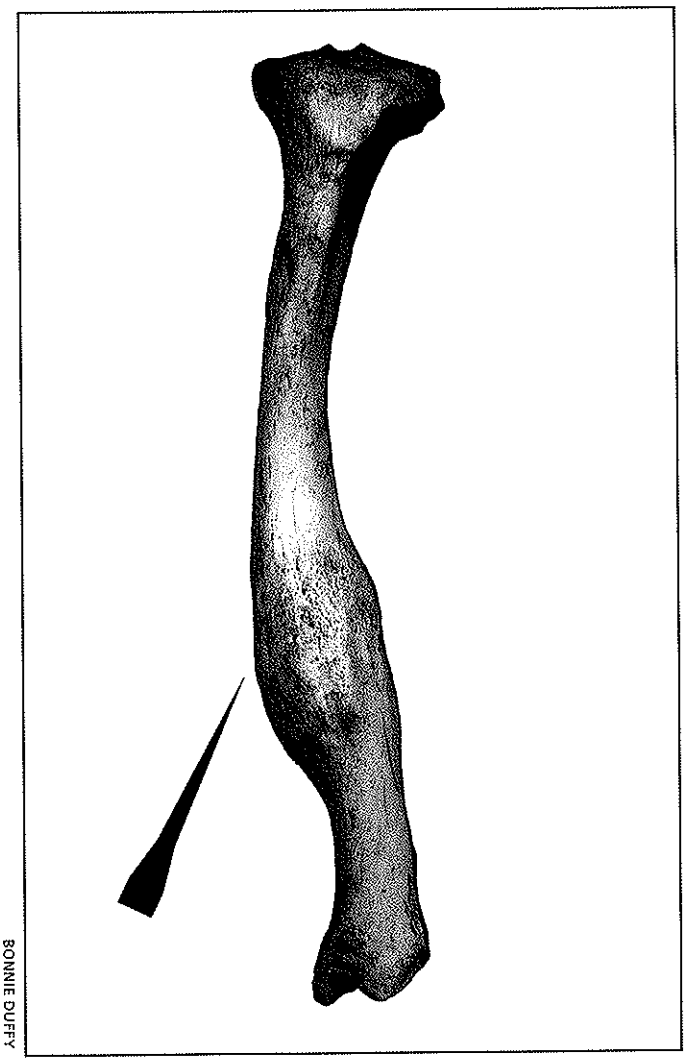
Docile, healthy young fawns offer the best potential for successful treatment and release. The location and nature of the break are critical. The timing of the process is also important. The authors explain the healing process of bone, and recommend treatment of closed fracture by internal fixation as giving the best chance for successful long-term healing.

KEY WORDS osteosynthesis, osteoblast, osteoclast, callus, pseudoarthrosis, comminution, osteomyelitis, septicemia, sequestrum (sequestra, plural), internal fixation, steel plate, interlocking nail, coaptation or external fixation, anesthesia, antibiotics, disuse-overuse window

ROBERT A. RICHARDSON, DVM, is a veterinary orthopedic and neurosurgeon in northern California. He works out of the Sacramento Veterinary & Surgical Services and the Campus Commons Pet Clinic in Sacramento. He has been in specialty practice since 1975.

SALLIE REYNOLDS has been a rehabilitator for eight years with Sierra Wildlife Rescue in Placerville, California. She works primarily with fawns and raptors.

J. Wildlife Rehab. 27(1): 16–20
© 2004 International Wildlife Rehabilitation Council



BONNIE DUFFY

Figure 1. Tibia of a wild adult mammal (the bone was found in the wild) showing callus (arrow) around a healing break. The twist in the shaft indicates some movement at the site during the healing process, but not enough to prevent healing. Here, the remodeling process has proceeded well. Had the animal lived, the bone would have continued to modify its appearance on the balance of osteoclast and osteoblast activity, and eventually the callus would have remodeled to become hard adult bone.

How Bones Heal

Fractures and trauma induce stem cells, abundant in bone marrow, to become osteoblasts, osteoclasts, fibrocytes, and cartilage cells. In ideal circumstances, these cells develop in specific proportion to provide the orderly repair of the fracture. Initially, clots, muscle, and fibrous callus act as a large, soft internal "bandage," leading to successful nonsurgical healing of many fractures by stabilizing the fracture ends with scar, cartilage, and bony ingrowth (Figure 1). Usually a substantial callus forms within days of the injury, especially in young animals. If the site heals properly, the callus will be remodeled, with most of it replaced eventually by hard, adult bone.

In repairing fractures, rigid internal fixation—a surgically implanted steel plate or an interlocking nail/pin—encourages an ideal osteosynthesis through osteoblast-to-osteoblast reconstruction. In this scenario, bone cells on each side of the fracture begin to interdigitate, like interlocking fingers, bypassing each other and forming a knit with very little callus.

External devices (coaptation), such as splints, casts, or braces for pins, will "approximate" the bony fragments (i.e., get them close to each other but not perfectly aligned), and callus then becomes an important element in healing.

Some motion at the fracture site stimulates the formation of callus and a good healing process. Too much motion, however, causes osteoblasts to morph into fibrocytes or cartilage cells and to cease reconstructing bone. This can turn the callus into a nonunion, and eventually a "false joint," or pseudoarthrosis. In this scenario, the injury remains an unhealed fracture. Since callus is the material that is usually "rebroken" when repair is interrupted, callus formation and bone reconstruction must outpace pseudoarthrosis.

When a balance between the two can be maintained, however, healing occurs: as osteoblasts create bone, osteoclasts recanalize bone for blood vessels to revitalize the area, and help dissolve very small devitalized bone chips.

Assessing Patients

Each fawn and each fracture should be carefully and individually evaluated before the rehabilitator and surgeon together decide the best course for the animal. In general, the ideal candidate for bone-repair surgery has the following characteristics:

- Overall good health
- A fresh, noncomminuted (two pieces of bone), closed midshaft fracture of a leg bone
- Age no more than 3 months and weight of 10–30 kg (5–15 lbs)
- Docile temperament that allows the fawn to tolerate stress
- A minimum of 6 weeks between time of surgery and release

Age and weight are important, as fawns older than about 3 months are more likely to become stressed and to panic. Older fawns typically weigh 77–88 kg (35–40 lbs). They are extremely strong, and capable of injuring both themselves and the people working with them.

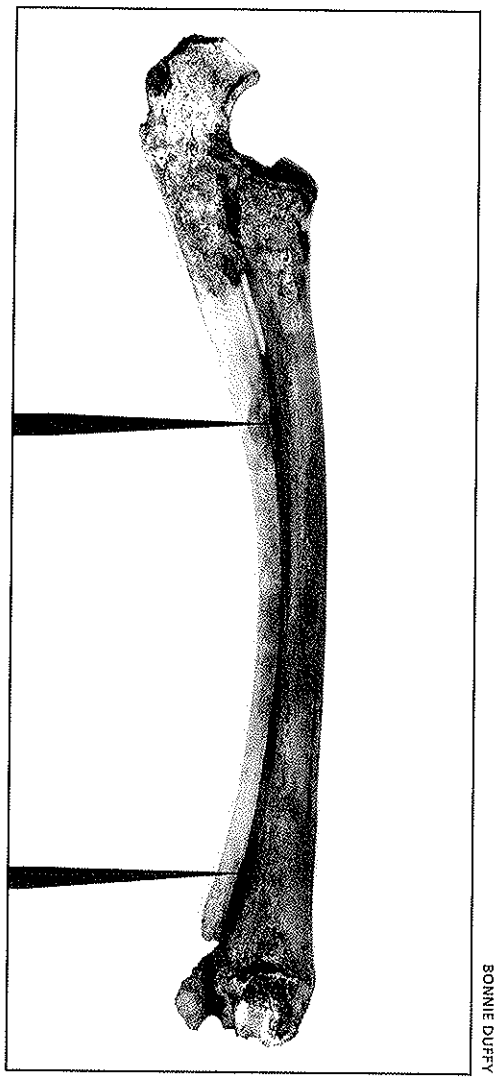
The ability to tolerate the stress associated with handling and treatment is critical. Fawns succumb to stress-related illness and dysfunction more readily than many other wild animals. (It is not unusual for the stress of being handled, added to the shock of injury—even when the injury itself is not life threatening—to kill a fawn.)

A fresh, non-comminuted fracture is in many ways the most important factor of all. More complicated breaks can lead to complications in healing, as will be explained below.

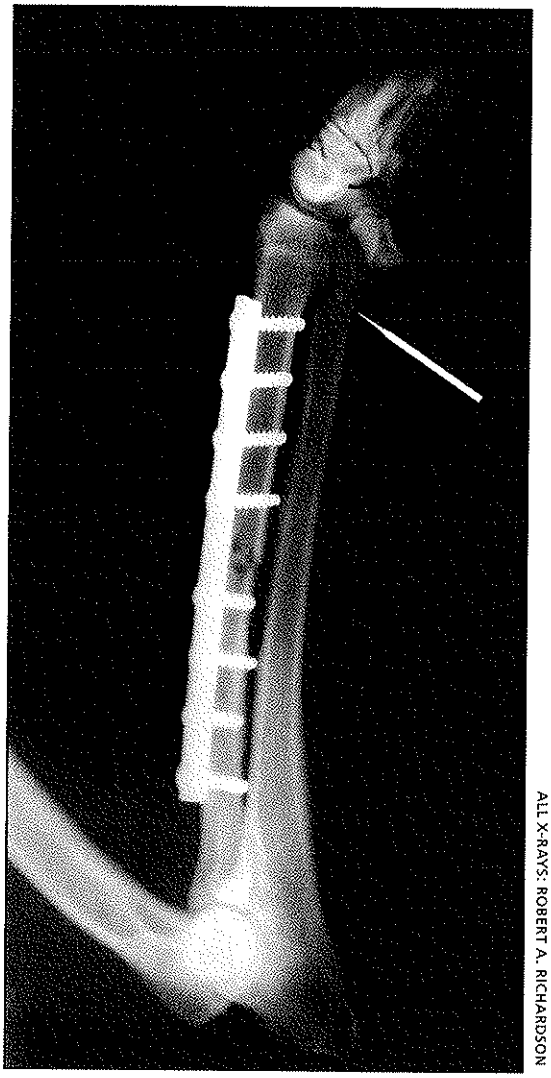
Finally, the timing needs to be right. To succeed in the wild, a fawn should be released in a group of other fawns by early to mid fall of its birth year. This gives it the best chance of learning how to find food and avoid predators, and so survive the coming winter. The rehabilitator should look for at least a 6-week window for treatment.

Figure 2 (Right). Mule deer radius/ulna, found in the wild, showing the fusion of the two bones in adult cervids. The bones are separate in fawns, the shaft of the radius crossing over to the cranial end of the ulna. They fuse in this position with maturity (arrows). The ulna shaft and distal end are greatly reduced, in comparison to species in which these bones are separate. On the hind leg in cervids, the fibula is present only at its proximal end, a tiny vestige that fuses onto the tibia, and at its distal end, where the lateral malleolus persists as a separate bone. (Hillson 1995).

Figure 3 (Far right). Closed, non-comminuted midshaft fracture of the radius (domestic dog), repaired by plate. The arrow marks a fracture of the ulna that will heal without specific stabilization. This kind of injury can be successfully repaired in a wild animal.



BONNIE DUFFY



ALL X-RAYS: ROBERT A. RICHARDSON

A fawn that meets these criteria is a good candidate for successful surgical repair of the bone. With the right treatment and rehabilitation, the limb has a good possibility of regaining normal strength. (See Figures 2 and 3.)

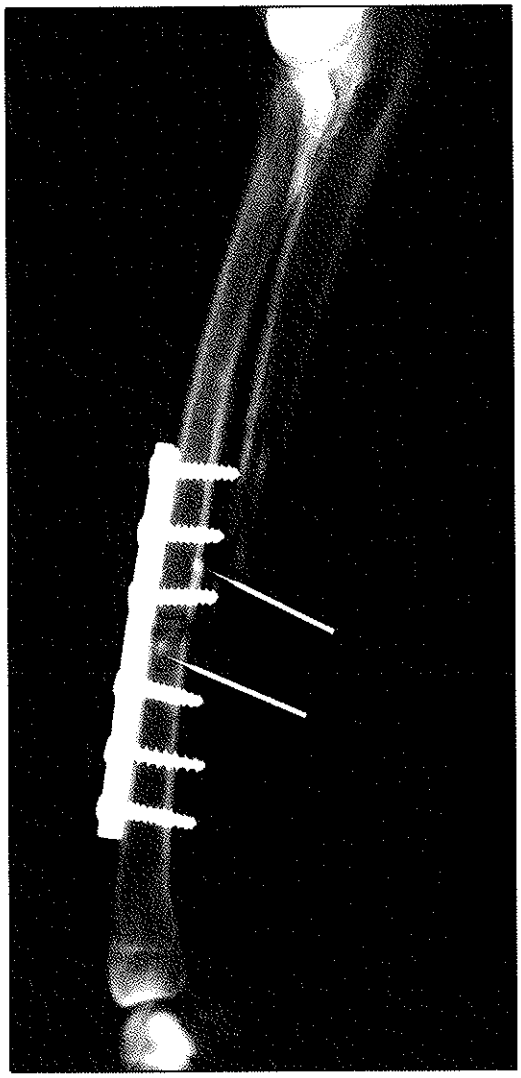
The Difficulties with Complicated Fractures

A comminuted fracture (one having multiple pieces of bone, as compared to the simple, two-piece fracture), an open break (the broken bone has punctured the skin), or a break in the joint adds complexities to the rehabilitator's and surgeon's evaluation of the patient. Comminution, joint facture, and some complications are usually best determined under anesthesia.

A ***comminuted fracture*** presents serious problems for the wild animal. In a domestic animal, the veterinarian can surgically repair the main fracture and leave the other pieces of bone at the site. The smallest will dissolve, and larger chips often revitalize and contribute to the repair. If these large fragments become devitalized, however, the animal must undergo surgery a second time to remove them (Figures 4 and 5). Left in place, these "dead" chips (called *sequestra* because they have become sequestered from the blood supply) can attract bacteria normally present in the blood stream. These bacteria then have the opportunity to accumulate, creating an infection. Without intense and sometimes prolonged treatment, the patient will die of septicemia (the persistence of pathogenic microorganisms or their toxins in the blood) resulting from osteomyelitis, itself a severe inflammation and infection of the entire bone. The animal might appear to be healed because the infection can spread slowly, but eventually it would kill the fawn. Unfortunately neither a second surgery nor lengthy antibiotic treatment is a good option for wild animals.

Joint fractures, even when they can be treated, present difficulties that can affect long-term success. First, the joint must be repaired to be functional on Day 1 post-op, or it will probably never return to normal. Second, over time any repaired joint may develop arthritis, which can later cripple an animal despite good fracture healing. Deer often live 8–10 years in the wild, ample time for arthritic complications.

An ***open or compound fracture*** is, by definition, contaminated. If it is neglected even for a matter of hours, it can become infected, and the fawn may develop osteomyelitis. Animals with open fractures require much more intensive treatment and prolonged monitoring, sometimes for months. It is generally a good idea to culture the site in order to administer the correct



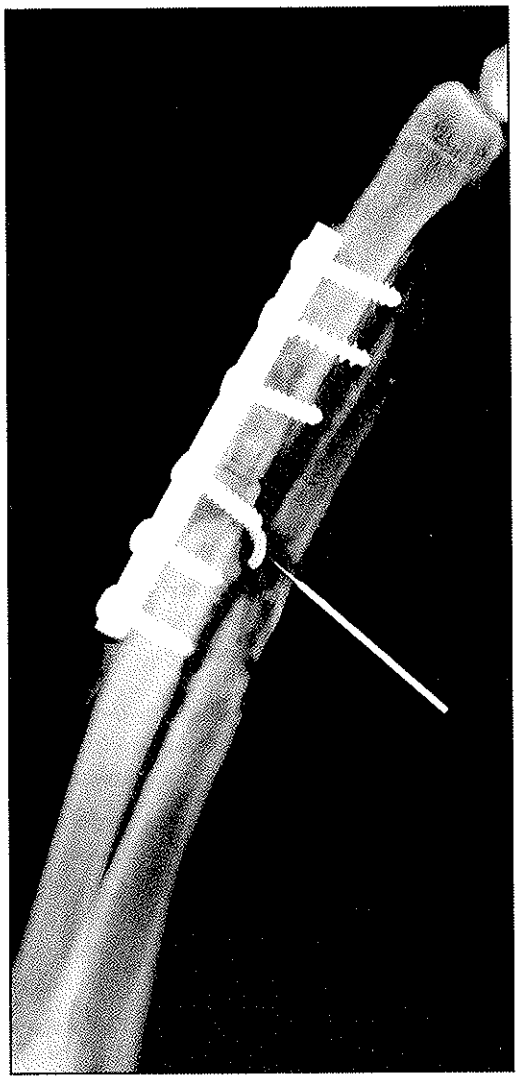


Figure 4 (Far left). Comminuted radius fracture (on a domestic dog) shortly after it has been plated. The arrows point to large bone chips. In a domestic animal, these may be left in place with the hope that they will remain vital and become part of the repair. In wild animals, however, the presence of these chips indicates a fracture that is nonrepairable.

Figure 5 (Left). The repair shown in Figure 4, after a few weeks, showing a "dead" bone chip (arrow) that must be removed through a second surgery in order to prevent infection. The whiteness of this chip indicates an increased density (living bone is more porous), in comparison to vitalized, healing bone, which appears grayer on X-ray. A second surgery is not recommended for wild animals, so the presence of large bone chips at the fracture site should rule out the possibility of repair.

antibiotic. All these factors create stress for the patient. When assessing a fawn with an open fracture, the rehabilitator and surgeon should carefully consider what kind of handling the treatment calls for and how long the animal can be kept in captivity before stress or release considerations become critical.

Additional Complications

Forelimb fractures may be accompanied by wounds to the chest leading to pneumothorax (free air in the chest from lung trauma). This must be treated before anesthesia can be safely administered. Hind limb and pelvic breaks may involve bladder or spinal injuries. The presence of these traumas should be determined before deciding on the wisest course for the animal.

Treatment

For a fawn that meets the criteria for surgery described above, internal fixation—a steel plate or an interlocking nail (a pin/nail that fits in the marrow cavity, with locking screws at the ends)—offers a permanent surgical repair. The bone grows up over the edges of the nail or plate, and the body completely adopts the device. (If both the paired bones are broken, the radius or tibia can be plated and the ulna or fibula, stabilized and aligned via the plate on the larger bone, left alone, as it is with dogs.) With proper postoperative care, the healed bone should become strong enough to sustain the deer's normal activities.

Internal fixation is effective because it is rigid, providing the best environment for osteoblast-to-osteoblast mending: the stability provided by the plate or nail protects the osteoblast from sheering forces and axial rotation, reducing callus formation and osteoclastic activity. A strong, life-long repair is thus achieved.

Minimizing stress and handling is also best achieved with internal devices, because they require little handling post-op and provide the earliest and most comfortable return to normal use. Equally important, with plate or nail, the patient is subjected to anesthesia one time only. (For this reason, absorbable sutures are essential.)

Animals do not fare well with coaptation or external fixation devices (splints, casts, and braces that hold pins in place). They find these uncomfortable, and have been known to break them off. Even when healing has gone well, their removal involves stress and possible subjection to a second round of anesthesia, and may lead to disastrous trauma. External fixators should, therefore, only be used in select cases.

Final Evaluation and Surgical Procedure

Anesthesia presents one of the greatest challenges in working with any animal, and its administration varies from species to species. Both before induction and on recovery, the patient must be kept quiet and its movements controlled to avoid further injury. Many rehabilitators have experienced the distress of having to euthanize an animal that trashes a successful surgical repair as it emerges from anesthesia.

Once the patient is anesthetized, X-rays of the site complete the evaluation of the injury. If comminution, joint fracture, or additional serious injury is present, the animal can be euthanized without waking. If these are absent, the surgeon can begin the repair.

Veterinary surgeons can choose the plate or interlocking nail for a fawn as they would for a domestic patient. Care should be taken not to select a plate that is too big, however, as it can overprotect the site, reducing the normal favorable stress that encourages healing and possibly causing the bone to weaken under and near the ends of the plate. During healing, plates are tightly adopted by the bone, and the proportional support of the healed bone and the plate provides protection from dangerous mechanical stress at the site during the healing process.

Since the closed fracture provides an initially sterile condition, antibiotics can be given twice: on induction of anesthesia and at wound closure. Thereafter, the fawn does not need to be handled for antibiotic medication.

After surgery, the leg may be wrapped in a thick, padded bandage until the animal wakes up sufficiently to stop thrashing. The padding may be awkward, but it will prevent extreme leverage on the fracture site, which could destroy the repair. It will, of course, require a second handling to remove, so how well the fawn will tolerate that should be considered when deciding whether or not to pad. The bandage may be removed before the patient goes into a cage or enclosure and begins to move more normally.

Return to Normal Function

The most important factors in post-operative healing that rehabilitators can work to control are the proper use of the injured leg and nutrition.

Deer, like all species, have specific dietary needs at different stages of growth. Although it is difficult to provide an entirely "natural" diet, there are ample resources available to the rehabilitator that describe the appropriate nutrition for each stage of the fawn's development, and the various strategies for making sure that the fawn actually takes in the food. Adding calcium to the healing patient's diet is seldom necessary, since the fracture site will "capture" the calcium it needs from the body. A good diet, with the correct calcium:phosphorous ratio, should be adequate.

Recovery is most successful with patients who quickly begin bearing a certain amount of weight on the repaired limb, and then gradually increase the weight over time. This process is admittedly difficult to control with animals. However, if the gradual reintroduction of activity is not accomplished, the animal may well destroy the repair.

First, protect the fracture site by keeping the fawn in a small space. This is most easily accomplished by dividing a large pen into several small sections that are padded with burlap sacking or the like. (It is best, of course, if the fawn cannot see its human helpers.) After the initial restriction, slowly increase the fawn's level of activity by opening more sections of the pen as healing progresses. Once the repair is stable, usually 3–4 weeks after surgery in youngsters, the bone starts to regain its supportive integrity, and the plate or nail becomes increasingly unimportant. At this point the fawn can be moved to a large release enclosure, preferably with other fawns, and may resume normal activity. In this way, the fawn experiences the herd atmosphere and "wilds up" appropriately for release.

Conclusion

Working together, the rehabilitator and veterinary surgeon can successfully treat some fawns with a broken leg by controlling important factors that influence healing. This begins with a candidate whose calm personality, basic good health, and uncomplicated fracture combine to offer a good prognosis. Next, it is important to provide the proper surgical repair and attend to nutrition and stress management postoperatively. Finally, make sure that recovery proceeds without serious setback.

If we succeed in these things, the fawn should be ready 6–8 weeks after the surgery for release into supportive habitat with a "rehab herd"—and has a very good chance of growing to maturity and living a full and natural life.

References

Gilbert, B. M. 1990. *Mammalian osteology.* Columbia: Missouri Archeological Society.

Hillson, S. 1995. *Mammal bones and teeth: An introductory guide to methods of identification.* London: Institute of Archeology, University College.

To Contact the Authors

Sallie Reynolds
Tel: 530/333-1310
E-mail: sfrswr@aol.com

Authors' Note

In the time between the conception and publication of this article, no fawn was brought to Reynolds' organization with a treatable break, so there is no patient history for illustration. The surgery, however, has long been successful in domestic mammals. Readers with experience in this kind of problem in wild mammals are asked to contact Sallie Reynolds.

International Wildlife Rehabilitation Council

Certification Program

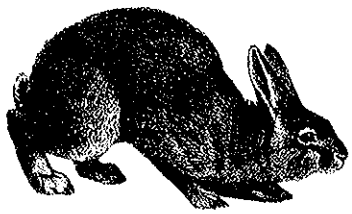
International Wildlife Rehabilitation Council, at its annual meeting in November 2003, established a certification program for wildlife rehabilitators. Successful completion of the IWRC 1AB Wildlife Rehabilitation class and attendance at two IWRC or NWRA Annual Conferences entitles you to apply for **CHARTER-LEVEL CERTIFICATION.** If you would like to enroll as a certified charter-level rehabilitator, you can apply **RIGHT NOW** by sending copies of your 1AB certificate and proof of attending two national conferences (IWRC or NWRA), along with your $25 check to:
IWRC, 8080 Capwell Drive Suite 240, Oakland, CA 94621

The IWRC Certification Program benefits wildlife professionals who wish to pursue a formal certification and join a registry of others who qualify as certified Wildlife Rehabilitators in a standard, recognized way. There are several important benefits to an IWRC certification:

- Recognition by the public and professionals
- Certification may be required by a particular rehabilitation center or group
- Proof of competence in your field
- Demonstrates a commitment to excel in your field
- Certification is portable; your skill-set goes where you go, and it is backed by the IWRC Certification Standard

Information and a survey regarding this program as well as a new training plan with both instructor-led and distance-training options can be found under "New Training Plan" on our website:

http://iwrc-online.org/training/newplan.cfm



SUCCESS STORY

A Twice-Injured Sharp-Shinned Hawk (*Accipiter striatus*)

by Louise Shimmel

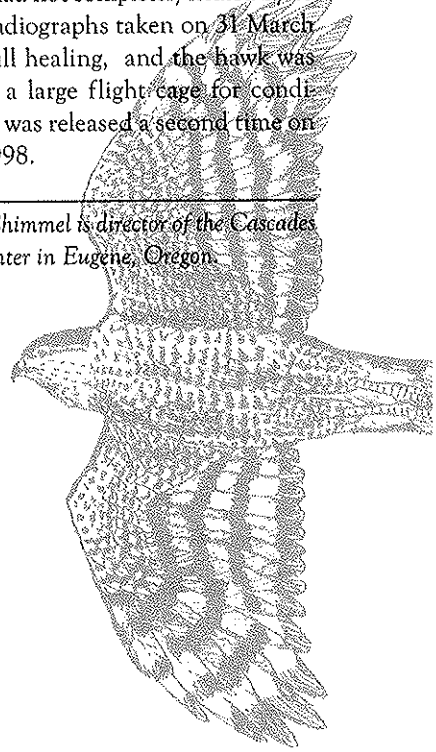
An immature female sharp-shinned hawk (*Accipiter striatus*) was found by a homeless person under an overpass near a park in Eugene, Oregon, on 17 December 1997. The bird was in good flesh (154 g), bright, alert, and responsive, and gave us a bit of a chase before it was captured. Radiographs revealed a closed fracture of the left ulna in fairly good alignment. Because the radius was intact and the alignment of the fracture itself was good, we opted not to surgically pin the ulna. No antibiotics were needed, and the hawk was eating well from intake, so no daily handling was anticipated.

The wing was immobilized with a figure-8 wing wrap, and although a hematoma formed—which was discovered on a wrap change on 21 December—the bird was flying by 29 December. (As often is the case with accipiters, it was not *our* idea to test the hawk's flight capability that early....) Given its penchant for rushing the hospital cage door during cleaning or feeding, the hawk was moved to a small outside enclosure on 30 December for a week, and then to a large enclosure on 6 January 1998. It was flying quite well and was at a weight of 206 g when banded and released on 13 January, near the capture site in a park near the Willamette River in downtown Eugene.

On 2 March 1998, some 7 weeks later and 5 miles from the release site, the hawk hit the window of a volunteer's house and re-broke the same bone in the same wing in the exact same place. The bird was identified by its band number. Intake weight was 164 g, which although less than her release weight, was 10 g above her original capture weight in December. The hawk was well fleshed and feisty. Obviously, we were concerned that its earlier release might have been premature, but clearly she could not have survived for 7 weeks if the wing had not been fully healed. Sharp-shinned hawks are not carrion eaters, but amazing aerial predators whose primary prey is song birds. This bird would not have been able to catch the food necessary to maintain its weight over that time period and move such a distance with a handicapped wing.

There was a fresh hematoma above the fracture site that was opened; a blood clot removed after a week. There was no sign of infection. Healing was a bit slower this time, and case records indicate that the bone had not completely healed by 18 March. Radiographs taken on 31 March showed full healing, and the hawk was moved to a large flight cage for conditioning. It was released a second time on 6 April 1998.

Louise A. Shimmel is director of the Cascades Raptor Center in Eugene, Oregon.





PEREGRINE FALCON CHICKS PHOTO: USFWS

Do you have an easy answer to a frustrating rehab issue? A new way to resolve a common problem?

Share it!

Please send your "Simple Solution" to the Editor at runmuki@yahoo.com. If possible and appropriate, please include high-resolution (300 ppi) digital images, as well as a brief (one- to three-sentence) note about yourself.

Bugs & Drugs

VACCINES AND SPECIFIC IMMUNITY

by Kathy Dolan

Vaccines are used in many different areas of animal health. Companion animals, such as cats and dogs, are routinely vaccinated against a wide range of diseases. In agriculture, numerous vaccines are used to protect food animals against many infectious diseases that could have catastrophic consequences on the food supply. Rare and valuable collections of animals in zoos are vaccinated to safeguard them against disease. While vaccinations protect an individual against a specific disease or lessen the severity of that disease, the main goal of vaccinations is to prevent the entry or spread of an infectious disease into susceptible populations. Vaccination programs have been initiated within the last 20 years to protect populations of endangered wildlife from diseases such as canine distemper (CD) or variants of CD, and more recently West Nile virus. Other wildlife vaccination programs have been aimed at preventing the spread of rabies among mammals, such as raccoons and foxes. As the field of wildlife rehabilitation grows, awareness and discussion will increase regarding the possible use of vaccines in rehabilitation. This article will provide a brief look at specific immunity and types of vaccines, using human and animal vaccines as examples.

Animals are protected from disease by pathogenic microbes by the immune system. This system can be divided into two parts: nonspecific and specific. Non-specific immunity includes physical and chemical barriers such as intact skin, hydrolytic chemicals, and increased stomach acidity, as well as ciliated mucous layers within the respiratory system that entrap and sweep away foreign objects. Within the blood and tissue, phagocytic cells engulf and destroy foreign invaders. These defenses are intact at or shortly after birth, regardless of exposure to pathogens. Repeated exposure to the same pathogens does not improve the speed or strength of these barriers.

In contrast, specific immunity is an adaptive response that requires prior exposure of an animal to a pathogen or its toxins. While many processes and cells are responsible for the development of specific immunity, the key players are antigens, B-cells, antibodies, and memory cells. Antigens are parts of proteins or polysaccharides of pathogens that stimulate B-cells, a class of white blood cells, to produce antibodies that bind and neutralize only that specific antigen. Antibodies are immunoglobulins (Igs), large protein molecules that circulate in the blood, making up a large portion of the plasma solids. Binding of antibody to pathogens can prevent pathogens from colonizing the animal, and thus prevent disease. Concurrent with antibody production, B-cells also produce a set of specific memory cells. Memory cells are responsible for long-term specific immunity. Memory cells have long life spans: some live as long as the animal, providing life-long immunity. During subsequent encounters with the same antigen, memory cells become activated and begin to produce that particular antibody again and *more* memory cells. With each exposure to the same antigen, the specific immune response to that antigen becomes stronger and faster. This mechanism means that the B-cells and their products *adapt* to a *specific* antigen or pathogen. Without prior exposure, long-lasting specific immunity does not develop.

Types of specific immunity

There are two types of specific immunity: active and passive. Active immunity is produced when an animal is stimulated to produce its own antibodies and memory cells either by contracting the disease and recovering from it or by receiving a vaccination. In either case, the animal's body is actively engaged in antibody and memory cell production. Active immunity can give long-lasting protection against some diseases.

With passive immunity, the animal or person receives pre-formed antibodies, collected from a vaccinated animal, against a particular pathogen or toxin to which the victim was exposed. Preformed antibodies provide immediate, but temporary protection to the recipient. Within days or weeks the recipient's body destroys the donated antibodies. Examples of passive immunity are snake anti-sera and rabies anti-sera. This immunity is called passive because the recipient does not produce his or her own antibodies or memory cells.

Passive immunity also includes the transfer of maternal antibodies to offspring either through the placenta or colostrum (first milk). Avian and reptilian offspring absorb maternal antibodies deposited in the egg before fertilization. Maternal antibodies provide temporary protection from disease until the offsprings' own immune systems can begin producing protective antibodies. The effectiveness of maternal antibodies depends on the quality and amount of antibodies present in the mother's serum. How long the maternal antibodies last within an individual will vary among species and even between littermates. While beneficial to the young animals, maternal antibodies can interfere with vaccines given to the offspring, thus preventing the animal from producing its own active immunity. This effect can be overcome by boosting young animals at regular intervals, as is done with canine parvo or distemper vaccines. Maternal anti-measles antibodies last approximately one year in human infants, which is why measles vaccinations are not given until an infant is at least one year old.

Types of vaccines

Vaccines contain either weakened or dead pathogens, or parts of pathogens that are administered to an animal with the goal of preventing disease when the pathogen is encountered at a later date. A vaccine should provide strong, reason-

Type of vaccine	Description	Advantages	Disadvantages	Examples	
				Human	Animal
Killed	Killed or inactivated virulent microbes	• Low chance of causing disease	• Damage to surface antigens • Multiple boosters • Possible reaction to adjuvant • Vaccine contamination by inactivating or biological agents	• Rabies • "Flu shots" • Polio (Salk)	• Rabies • Canine Lyme disease • Canine distemper (wildlife) • Canine parvo • Newcastle disease
Attenuated or modified-live vaccines	Living avirulent bacteria or virus	• Antigens intact • Reproduction in host • Extended exposure time to antigens • Reduced or no booster shots needed	• Can revert back to pathogenic form, causing disease • Development of disease in immunocompromised recipient	• Polio (Sabin) • Measles, mumps, rubella (MMR) • Chicken pox • Hepatitis A	• Canine disemper • Canine parvo • Equine herpesvirus • Newcastle disease
Toxoid	Inactivated bacterial toxins	• Intact microbe not delivered to recipient • Prevents toxin-based disease	• Possible reaction to adjuvant • Possible reaction to inactivating material	• Diphtheria, Tetanus, Pertussis (DTP or DTaP)	• Tetanus • various clostridial preparations for livestock
Subunit	Isolated antigens from pathogenic bacteria or virus	• Recipient exposed to only necessary antigens	• Possible reaction to adjuvant • Exposure of lab personnel to virulent pathogens • Expensive	• Bacterial pneumonia • Serum-derived hepatitis • Bacterial Meningitits	• *Escherichia coli* enterotoxins
Recombinant vaccines	Antigen genes cloned into plasmid or DNA viral vectors	• Elimination of disease development	• Limited use thus far, but gaining • Some delivery problems	Specific examples below	Specific examples below
Recombinant subunit	Cloned antigen genes expressed in laboratory cell cultures Recombinant antigens purified	• Increased safety for lab personnel	• Possible biological contamination • Not amenable for all antigens	• Hepatitis B • Acellular pertussis	• Canine Lyme disease
DNA vaccines	Cloned vector delivered directly to animal tissues	• Reproduction of vector in recipient • Recipient exposed to more antigen for longer period of time	• Sufficient quantity of cloned vector gaining entry to cells • Degradation of vector before sufficient antigen is produced • Integration of new DNA into recipient's own chromosomes	• HIV subunits (experimental)	• Avian West Nile virus (experimental) • Newcastle disease (experimental)

ably long-lasting immunity with minimal damage or adverse reaction in the vaccinated animal. The types of vaccines available are: attenuated, killed, subunit and recombinant, and toxoid.

Attenuated, Live-Modified Vaccines

These vaccines are prepared from living bacterial or viral strains that have lost their ability to cause disease through laboratory manipulations. Because these strains are still alive, they multiply within the vaccinated animal. Reproduction increases the amount of antigens and increases the length of time the weakened microbe is exposed to the animal. This allows a stronger immune response and a longer-lasting immunity to develop, reducing the need for boosters. A drawback to attenuated vaccines is the infrequent occurrence of reversion of the weakened pathogen to a more virulent strain, resulting in disease in the vaccinated animal. This reversion to a disease-causing strain was dramatically illustrated in the original Sabin attenuated polio vaccine, when two of the three attenuated strains in the vaccine reverted back to the more virulent form, resulting in poliomyelitis in either recipients or their caregivers. Many safeguards are now in place to reduce the chances of such tragedies.

Killed or Inactivated Vaccines

Cultures of virulent bacteria or virus are killed or inactivated, respectively, by heat or chemicals such as formaldehyde to produce these vaccines. Surface proteins are frequently the first antigens that an animal's specific immune system encounters, and against which antibody and memory are made. A drawback to these vaccines is that the treatments can alter the surface proteins. The resulting antibodies produced against the altered antigens may bind only weakly, or not at all to the untreated pathogen when it is naturally encountered. These vaccines deliver a limited amount of antigen and, since the pathogen and its antigens are not reproduced, a shortened exposure time. Thus with killed vaccines, the response is not always as efficient or as long lasting as with other vaccines. Strategies used to compensate for these shortcomings include increasing the amount of dead pathogen, booster shots, and suspension of the inactivated pathogen in an adjuvant. Adjuvant is a chemical that slowly releases the vaccine from the injection site, increasing the amount of time the inactivated pathogen is in contact with the immune system. While strengthening the immune response, adjuvants increase the risk of adverse reaction at the injection site. Killed vaccines are used where the risk of developing disease from the vaccine must be as close to zero as possible. For example, the most commonly used equine West Nile virus vaccine is an inactivated viral vaccine.

Subunit and DNA Vaccines

Subunit vaccines are produced by growing large cultures of the pathogen and purifying the antigenic proteins or polysaccharides. This material is then used, sometimes in combination with an adjuvant, as a vaccine. By administering only portions of a pathogen, the chance of developing side effects or disease is virtually eliminated. The acellular pertussis (aP) vaccine was recently adopted to replace the traditional killed whole-cell pertussis vaccine in the childhood diptheria-tetanus-pertussis (DTP) vaccine series. The change was recommended after a link between the whole-cell pertussis vaccine and brain disorders were noted.

Another strategy for producing subunit vaccines is by identifying and cloning the genes of the most antigenic subunits of a pathogen into either a plasmid or viral DNA vector. The recombinant vectors containing the cloned genetic information are then inserted into laboratory cell cultures. The cells act as living "factories" to produce large quantities of the subunits, which are purified and used as vaccines. Many cloned vectors can also be administered directly as DNA vaccines, allowing the vaccinated animal to produce the antigenic subunits needed to stimulate the immune response. Similar to the attenuated vaccines, the cloned antigen is made continuously over a period of time by the recipient's cells, eliciting a strong immune response. Whether used as a subunit vaccine or a DNA vaccine the potential for disease is completely eliminated in either method because neither the intact organism nor its genome is present in the recipient. To protect the condors in the American Southwest from the West Nile virus, the birds were captured and vaccinated with a DNA vaccine. The vaccine contains the genes for the surface proteins of West Nile virus and is currently being tested for use in other birds of prey. DNA vaccines have also been used to combat the spread of rabies in foxes, coyotes and raccoons. Baits laced with recombinant vaccinia (pox) virus containing the cloned rabies glycoprotein gene (VRG) are airdropped into designated areas for consumption by the target species. Although recombinant vaccine technology is still in its early stages, it shows exciting promise for the future of vaccine production.

Toxoid Vaccines

Toxoid vaccines protect the recipient from specific toxins produced by bacteria. These vaccines are prepared by inactivating bacterial toxins. The inactivated toxins are known as toxoids. When injected into the recipient, toxoids act as antigens to stimulate production of antibodies that will neutralize the toxins. Examples of toxoid vaccines in human medicine include the DTaP, which include toxoids from all three bacterial species. The human tetanus booster contains not only tetanus toxoid, but diphtheria toxoid as well. Although memory cells are developed, the specific immunity is not lifelong. Booster shots are required at regular intervals for continued immunity.

Vaccines provide protection against infectious diseases and their spread by "priming the pump" of an animal's specific immune system. Many different types of vaccines exist, each with unique pros and cons associated with its use. With the emergence of new infectious diseases among wildlife, there will be more awareness and use of vaccines to protect populations of endangered wildlife. JWR

Kathy Dolan, M.S., is currently residing in Nashville, Tennessee. She can be reached at k2dolan2001@yahoo.com.

Food for Thought

TAKING A BREAK

by Astrid MacLeod and Janine Perlman

Dear readers,

"Food for Thought" is taking a break, and we thought we'd leave you with some valedictory suggestions for continually improving your charges' diets and nutritional status.

1. First, last, and always, emulate nature.

Animals and plants, predator and prey have all co-evolved. Animals require all the variety and nutritional subtlety provided by their natural diets. We need to learn *what* happens in nature (including in our own backyards), and *why/how* it happens that way.

What happens in nature: Eastern bluebirds and Baltimore orioles both eat wild cherries, grapes, and berries, yet orioles, but not bluebirds, will sip from a hummingbird/oriole feeder.

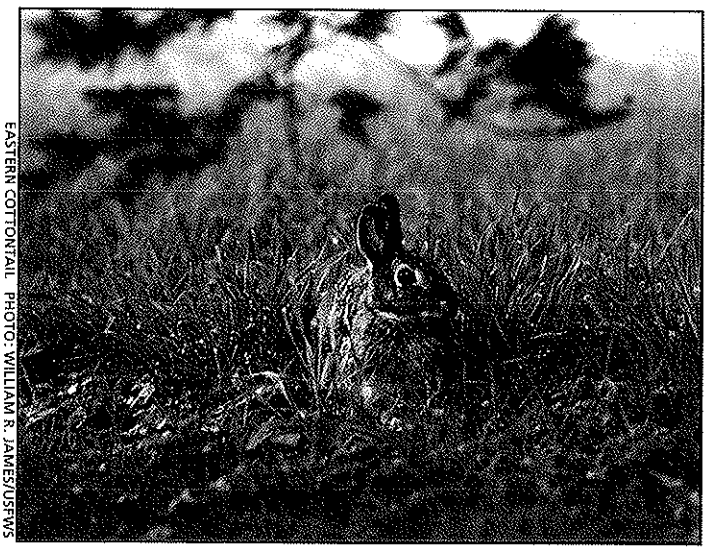
Why it happens that way: Bluebirds, as members of the thrush family, lack the intestinal enzyme that allows them to digest sucrose (table sugar). Wild fruits are generally very low in sucrose.

What happens in nature: An eastern cottontail doe nurses her young much less frequently than does a raccoon sow.

How it happens that way: Eastern cottontails nest on the ground. Because they are prey animals, they must make themselves as inconspicuous as possible. Infrequent and short feeding bouts lessen the threat of discovery, but necessitate adaptations. Young cottontails have a large stomach capacity, and a doe's milk is calorie-dense and rich in protein and fat; a large milk clot forms in the neonate's stomach and is slowly digested, providing the youngster with plentiful nutrients between nursing bouts. Eastern cottontails develop quickly, and are independent at an early age. Raccoon young mature slowly, by comparison. Having the ability to climb and nest in less accessible spots, raccoon females need be less concerned about predators, and have the luxury of nursing their young at frequent intervals; the female leaves her litter only for brief periods, to feed. Her milk is more dilute and less nutritionally dense than that of the cottontail doe because her young can nurse at will, because they develop less quickly, and because they expend less energy staying warm, thanks to their mother's presence. Raccoon milk would not meet the neonate cottontail's very particular requirements, while the dense, calorie-rich milk of the rabbit would cause diarrhea and dehydration in a neonate raccoon.

These examples allow us to draw obvious inferences about important aspects of feeding these animals in captivity.

There are countless natural phenomena that we can observe and can't yet explain, but we still need to replicate them. For example, unlike many species, American robins feed earthworms to their nestlings/fledglings, as part of their total diet. When raised in captivity, unless they are fed earthworms, some fraction of robins will develop malnutrition. They may exhibit abnormal feathers and/or "bubbled" bills, and/or die acutely. The specific nutrients essential to robins that are present in earthworms have not been identified, but this example reminds us that we must emulate the wisdom of nature, whether or not we currently understand underlying mechanisms.



EASTERN COTTONTAIL PHOTO: WILLIAM R. JAMES/USFWS

In the context of captive feeding,

2. The most important nutrients for growing animals (aside from water) are protein and calcium.

Whether the neonates in your care drink milk or eat insects (and calcium) or mice, their natural parents supply them with particular "baby foods" that are rich in water, animal-sourced protein, and calcium. It's obvious why: growing bodies require building blocks for tissues, organs, and skeletons. The exact amounts of these nutrients are crucial for young animals; they offer us very little margin of error. For the animals' sake, learn exactly what parents feed, and learn to use your calculator to provide the required amounts of these and other essential nutrients.

3. Never rush weaning.

We must always allow young animals to wean from handfeeding when *they* are ready, not when we're ready or we think they "ought" to be independent. Permit young animals to remain reliant on you for as long as they need to do so. We cannot be perfect parents, and wild animals are often delayed in maturation as a result of our shortcomings, or as a result of problems that occurred prior to intake. Animals are absolutely hardwired to become independent as soon as they are able. Remember that weaning and independence are behavioral milestones that are achieved gradually. One of the most important aspects of the practice of rehabilitation is patience.

4. Provide a variety of whole foods that are part of the animals' natural and seasonal diet.

This is essential for adult patients that come in recognizing and able to digest,

seasonally, only particular foods. It is crucial for weaning/juvenile animals, so that they will receive the nutrition they need for continuing growth and molt, and recognize the foods they need after release. It is equally important for long-term captives, because commercial diets do not supply the nutrients, choice, or stimulation (from mental to dental) required by captive animals.

In order to feed captive animals what they require, *rehabilitators must rely on scientific reports describing what is eaten in the wild.* "Secondary sources"—i.e., someone's interpretation of what animals eat and what they should be fed in captivity, or what other rehabilitators say "works for them"—are not necessarily reliable or accurate.

Only by offering a smorgasbord of natural foods will you...

5. Allow the animal tell you what it needs.

Sometimes injured or sick animals need nutrition different from what is eaten by healthy adults in the wild. When allowed to choose, these "picky" animals will almost always eat a diet higher in animal protein than "normal". One author treated a Gadwall (duck) for gunshot wounds. Although gadwalls are reported to be mainly vegetarian, for many weeks, the duck refused all food other than minnows or earthworms. The bird survived and went on to thrive. Because of stress and/or injuries and consequent infection, the duck apparently needed the nutrients found in whole prey.

Similarly, the authors were consulted on a siamang (gibbon) that had been fed an inferior diet and was ill. To address his problems, he was offered an array of whole foods that approximated the diet to which he had evolved. Initially, he chose large quantities of insects, egg, and chicken. After a period of recovery, his diet became more vegetarian and typical of his species.

6. Water is the most important nutrient.

All animals continuously lose water, and they require continual hydration. Severe dehydration presents with dry mucous membranes, tenting skin, sunken eyes, etc., but often, in moderate dehydration, the only symptom noted is depression. Since depression is caused by any number of other reasons for which animals are in rehabilitation, one of the best indications of normal hydration status is the continual production of dilute urine (wet, nondiarrheal droppings, in birds). Do not soak foods in electrolyte solutions, as further dehydration will result. Do not add less than the suggested amount of water to a milk replacer or other commercial product; "thicker" is not better: it is dehydrating.

Wildlife nutrition is an ever-evolving science, and one with which we are obligated to keep up, if we are to do as well by our charges as we can. We can create our own foundation for keeping informed by learning the basics about:

- Physiology of the species at different life stages
- Principles of nutrition
- Foods eaten in nature, at specific ages and seasons

An introduction to the fascinating world of animal physiology can be found in such texts as the classic *Animal Physiology* by Knut Schmidt-Nielsen. More advanced and specialized texts cover such taxa as mammals, birds, humans, and domestic species.

Basic principles of nutrition are described in *Wildlife Feeding and Nutrition* by Charles T. Robbins, and in a manual by the same name, by this column's authors, which is available from IWRC (www.iwrc-online.org; 510/383-9090). More specialized texts cover the nutrition of, for example, birds, humans, or farm animals.

The best source of information about foods eaten in nature by animals on the North American continent is *American Wildlife and Plants: A Guide to Wildlife Food Habits* by Alexander C. Martin, Herbert A. Zim, and Arnold L. Nelson. This book is more than 50 years old, but it is the only compendium of information on food actually taken from the stomachs of animals, and it is validated by more recent studies. Quality field guides are a source of general information, and they are far more reliable than other secondary sources, but they do not provide the detail and depth of this outstanding and affordable book. It is a book that no rehabilitator should be without.

For information on the composition of human foods, the USDA Nutrient Data Laboratory has an excellent and continuously updated website at www.nal.usda.gov/fnic/foodcomp/index.html.

Finally, the scientific literature is the only source of fully up-to-date information in this ever-evolving field. Wildlife nutrition draws from a wide array of disciplines, including biochemistry, physiology, ecology, nutrition, and much more. Peer-reviewed scientific literature is available at college and university libraries and, increasingly, online. We encourage you to go directly to these primary sources. If you don't feel qualified to interpret them, use information and interpretations provided by professional nutritionists who themselves publish peer-reviewed articles.

On a personal note, we appreciate the interest and support that our readers have shown over the time that this column has appeared here. "Food for Thought" may return in the future. Meanwhile, we invite you to continue to contact us on matters of feeding and nutrition for the animals in your care.

Sincerely,

Janine Perlman and Astrid MacLeod

Astrid MacLeod is a researcher, writer, and wildlife nutrition consultant. She serves on the nutrition advisory group of the American Zoo and Aquarium Association and the on the board of directors of Advanced Primate Ethical Studies. She works for Manitoba Conservation, and is an experienced rehabilitator of birds and mammals. She may be reached at sparrow@mts.net.

Janine Perlman, Ph.D., conducted laboratory research in biochemistry and molecular genetics for 20 years. She is now a comparative nutritionist and wildlife nutrition consultant. She serves on the nutrition advisory group of the American Zoo and Aquarium Association, and on the board of directors of Advanced Primate Ethical Studies. She rehabilitates birds and small mammals. She can be contacted at jpandjf@swbell.net.

The (Other) Value of Rehabilitators

PART I: WHERE, OH WHERE, DID THE DATA GO?

by Jennifer Hill

In the fall 2003 issue of the *Journal of Wildlife Rehabilitation*, wildlife rehabilitators are encouraged to not only collect data, but to collect *uniform* data (Watson 2004). Hear, hear! In his editorial, Joe Watson insists that we "make real measurements" and "share them with the whole community." Did this make you stop and think about your personal intake protocol?

Many of you already have standard intake procedures (interview finder, ascertain history since found, physical exam, etc.). Did you ever wonder who else might be interested in the weight of that particular gray squirrel or the plumage disposition of that female dark-eyed junco on intake? Whether you realize it or not, you have just collected data and therefore, have produced a resource. That resource may sit in your record book collecting dust and may never see the light of day (except for your federal and state annual reports). But someday, someone may look for a connection between degree of emaciation at intake and release rates in gray squirrels. Will you be confident of your data? Perhaps someone may look for a relationship between the number of fault bars per feather and ectoparasite load in dark-eyed juncos. Will you be certain that you had a female junco and not a male? In these instances, the data that you collect need to be accurate. In the junco scenario, you may have a photo of the bird, or regrettably, you may have the carcass, to verify the sex. However, some information, such as weight or degree of emaciation on intake, cannot be re-created.

I titled this article, "Where, Oh Where, Did the Data Go?" because I know that a vast majority of rehabilitators do not consciously collect inaccurate data or intentionally avoid collecting certain information. It seems that many wildlife rehabilitators might not have a concrete intake protocol that prompts them to collect all the information that might be of interest, now or in the future.

When we receive animals, typically, they are in pain and distress. We try to alleviate the pain and distress as quickly as possible. Sometimes, we are forced to skip aspects of an exam that could be very important. However, this may be the best decision for the moment. For example, if the bird is extremely traumatized and obviously has a broken leg, none of us would bother recording the number of fault bars on the feathers during the initial exam. Recording of this type of information can wait until the bird is stabilized and must be handled for another reason (e.g., moving into a larger pen). There are no hard and fast rules in rehabilitation. We must assess and decide based on the situation. Nonetheless, there are some pieces of information that should be recorded and must be accurate.

ACQUISITION #: _____

SPECIES: _____

LOCATION FOUND (BE SPECIFIC): _____

_____

DATE FOUND: _____ DATE DEATH: _____

FINDER NAME: _____

PHONE: _____

Below is a sample intake tag that is typical of specimens in a scientific museum. This tag includes the *minimum* amount of information that should be collected for a rehabilitation patient. A very thorough discussion of record keeping and information collection has already been produced (Moore and Joosten 2002a, b), and I will not replicate that information. However, a few points are important enough to warrant reiteration.

As scientists and rehabilitators who hope to collect "uniform" data, we must always accurately identify animals and use scientific names rather than common names. Perhaps you don't know the scientific name or you are unsure of your identification. In that case, use the purported common name and use additional resources (e.g., a field guide, another rehabilitator, or a wildlife expert) to confirm the identification and the scientific name. The Internet is a wonderful resource for information and for contacting experts from around the world. When I am unsure of the identification of a raptor, I send a picture to the Raptor Care listserve, which is an Internet group of raptor rehabilitators and enthusiasts from around the world. In this way, I am rewarded with dozens of expert opinions and am confident of my final identification.

Another extremely important piece of information is the "location found." In the sample intake tag, the collector is encouraged to "be specific"! Specific can mean many things, but most importantly, it must be enduring. For example, "Beside the barn on Old Man Johnson's farm" would not be a reliable location to record. The information we collect must endure and be accessible decades into the future. For example, many of the birds we received at the Museum of Southwestern Biology in Albuquerque, New Mexico were from window kills at the World Trade Center towers in New York. Our specific locations were simply, "Tower 1" or "Tower 2." We never considered the possibility that those

locations would not exist in the future. An extreme example, but it makes the point. What types of locality data are enduring? Good systems for producing locality data include GPS (global positioning system) data, legal land descriptions (township, range, section), and lat-long (latitude and longitude) data. Although it could be argued that these data might not be completely timeless (i.e., satellites responsible for GPS data could cease to exist), I think I'll put my money on the longevity of a satellite over Old Man Johnson's barn.

Hopefully, this article has made you think twice about some of the data you collect as a wildlife rehabilitator. Perhaps you have gained a different perspective on your data and what those data might mean to a researcher in the future. In future columns I will address the "other" value of rehabilitators. We not only treat sick and injured wildlife, we also collect data and should know how to be good stewards of that information. JWR

References

Moore, A. T., and Joosten, S. 2002a. Admitting: Identification of individual patients in captivity. In *NWRA principles of wildlife rehabilitation: The essential guide for novice and experienced rehabilitators*, edited by A. T. Moore and S. Joosten. St. Cloud, Minn.: National Wildlife Rehabilitators Assn.

———. 2002b. Admitting: Keeping records. In *NWRA principles of wildlife rehabilitation: The essential guide for novice and experienced rehabilitators*, edited by A. T. Moore and S. Joosten. St. Cloud, Minn.: National Wildlife Rehabilitators Assn.

Watson, J. 2004. The value of uniformly collected information on rehabilitation cases. *J. Wildlife Rehabilitation* 26(3): 2.

Jennifer Hill completed her Ph.D. in animal behavior at the University of New Mexico. While at UNM, she worked at the Museum of Southwestern Biology in the Division of Birds as a curatorial assistant. Currently, she is the director of NorthWings, a raptor rehabilitation and education program at SEE-North, a nonprofit environmental education center. She can be reached at northwings@seenorth.org.

SELECTED ABSTRACTS

AVIAN

Diet Composition of Common Ravens Across the Urban-Wildland Interface of the West Mojave Desert

by W. B. Kristan III, W. I. Boarman, and J. J. Crayon

Wildlife Society Bull. 32(1):244-253

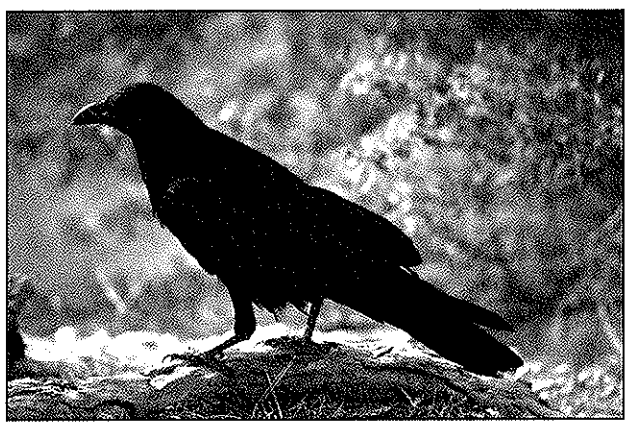
Common ravens (*Corvus corax*) are human-subsidized scavengers and predators in the Mojave Desert. They have increased dramatically in numbers and have been implicated as contributors to the decline in desert tortoise (*Gopherus agassizii*) populations. Known patterns of increased fledging success near human developments suggested that food was the most likely resource subsidy received by ravens. Because ravens are opportunistic foragers with a generalist diet, the authors predicted that the types of resource subsidy provided by different kinds of human developments should be reflected in measures of diet composition of breeding ravens. They estimated diet composition from contents of raven pellets collected at nests and related diet composition to distance of the nests from roads and point sources of resource subsidies, such as towns or landfills. Ravens that nested close to point subsidies far from major roads had the greatest incidence of trash in their diets. Ravens that nested close to roads but far from point subsidies had a low incidence of trash and a higher incidence of presumably road-killed mammals and reptiles. Ravens far from both roads and point subsidies had more plant material and arthropods, and ravens closed to both roads and point subsidies had more birds and amphibians. Diet diversity was not related to distance from roads or developments. Fledging suc- cess was correlated with diet composition, such that birds with diets consistent with trash or road-kill subsidies fledged the greatest number of chicks. The results suggest that ravens forage opportunistically on foods available near their nests, and different kinds of human developments contribute different foods. Improved management of landfills and highway fencing to reduce road-kills may help slow the growth of raven populations in the Mojave.

Effects of the Mosquito Larvicide GB-1111 on Bird Eggs

D. J. Hoffman, P. H. Albers, M. J. Melancon, and A. K. Miles

Environmental Pollution 127(3): 353–58

Golden Bear Oil (GB-1111; legal trade name for GB-1313) is a petroleum distillate used in the United States and other countries as a mosquito larvicide. As part of an evaluation of the potential effects of GB-1111 on birds, fertile eggs of mallards (*Anas platyrhynchos*) and bobwhite (*Colinus virginianus*) were incubated in the laboratory, and treated on Day 4 of incubation with external applications equivalent to either 0, 1/3, 1, 3, or 10 times the maximum rate (X) of 47 l/ha (5 gal/A) of field application of GB-1111. Hatching success was significantly reduced in mallards treated at 3 and 10 times the maximum field application, with a calculated approximate LD50 of 1.9 times the maximum field application. Most mortality occurred within a week of treatment. Hepatic P450-associated monooxygenase activity (ethoxyresorufinOdealkylase; EROD) was negatively related to dose. In the 3X group there



RAVEN PHOTO: GARY M. STOLZ

was a significant increase in the concentration of hepatic reduced glutathione (GSH) but a decrease in proteinbound thiols (PBSH). Hatching success of bobwhite was marginally reduced at the highest level of treatment (10X). Other effects at this level in bobwhite included a significant increase in incidence of abnormal embryos or hatchlings, lower body and liver weights, and a two-fold increase in hepatic microsomal EROD activity in hatchlings. The recommended maximum rate of field application of GB-1111 is unlikely to impair the survival or development of bobwhite embryos but is potentially toxic to mallard embryos under conditions of larvicide drift or spray overlap.



RACCOON (*PROCYON LOTOR*) PHOTO: DAVE MENKE/USFWS

MAMMALS

A Multi-Resolution Assessment of Raccoon Den Selection

by C. M. Henner, M. J. Chamberlain, B. D. Leopold, and L. W. Burger Jr.
J. Wildlife Management 68(1): 179–87

Many studies have been conducted on the ecology of raccoons (*Procyon lotor*), while few have examined raccoon den-site selection, particularly in agricultural and prairie landscapes. Furthermore, no studies have examined selection of den sites at multiple spatial scales. The authors examined den-site selection for 48 raccoons during 1997–1999 in an agricultural landscape in the Black Prairie physiographic region of east-central Mississippi. Den types selected differed by gender and season. Females used more cavity dens during young rearing, whereas males selected ground dens and brush piles. Den sites were located closer to crop fields, roads, and macrohabitat edges than random points. At the landscape level, den sites were associated positively with woody patch size, amounts of woody and grass edge, number of available patches of crop fields, and available area of lakes and ponds. Composition of habitats around den sites differed from composition of habitats within home ranges, and this difference also was noted by gender. Female raccoons selected crop fields, whereas males selected lakes/ponds relative to composition of habitats within their respective home ranges. The results indicate the importance of tree cavities to females during young rearing, particularly on prairie landscapes. Furthermore, the findings suggest that on prairie landscapes, availability of foraging habitat and water may influence den-site selection. The authors suggest that raccoons select den sites based on a perceived arrangement of required resources and that landscape configuration is important in the den-selection process. Evidence suggests that managers may selectively remove den sites as a non-lethal means of managing predation by raccoons.

A Genetic Assessment of the Eastern Wolf (*Canis lycaon*) in Algonquin Provincial Park

by S. K. Grewal, P. J. Wilson, T. K. Kung, K. Shami, M. T. Theberge, J. B. Theberge, and B. N. Whitea
J. Mammalogy 85(4): 625–632

Recent genetic data indicate that the eastern wolf is not a subspecies of the gray wolf (*Canis lupus*), but is a North American wolf more similar to the red wolf (*C. rufus*) and closely related to the coyote (*C. latrans*). The eastern wolf has been proposed as a separate species, (*C. lycaon*). The largest protected area containing this wolf is Algonquin Provincial Park in Ontario, Canada, which is bounded to the south by areas containing the Tweed wolf or eastern coyote, a hybrid of the western coyote and eastern wolf. The authors assessed the relationships of animals in the park by using DNA profiles that comprised the genotype from 17 autosomal and 4 Y-linked microsatellite loci and the mitochondrial DNA control region. These profiles were used to establish maternity, paternity, and kin relationships for 102 wolves that were studied from 24 packs over a 12-year period. Genetic data do not support the hypothesis that a pack comprises an unrelated breeding pair and their offspring. There is evidence of frequent pack splitting, pack fusion, and adoption. Some unrelated individuals in the packs were identified as immigrants into the park. High levels of genetic structuring were found between the Tweed wolves to the southeast and the Algonquin Park wolves (RST = 0.114). Lower levels of genetic differentiation with animals to the north and west (RST = 0.057 and RST = 0.036) and high genetic diversity suggest that park animals are not an island population but the southern part of a larger metapopulation of *C. lycaon*. *[©2004 Am. Society of Mammalogists]*

Rehabilitation and Post-Release Monitoring of Steller Seal Lion Pups Raised in Captivity

by M. E. Lander and F. M. D. Gulland
Wildlife Society Bull. (4): 1047–53

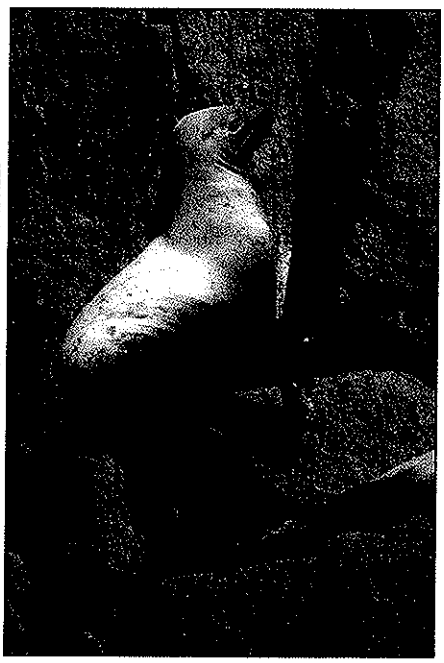
Three stranded Steller sea lion (*Eumetopias jubatus*) pups were retrieved from Año Nuevo Island, California, and admitted for rehabilitation to the Marine Mammal Center (Sausalito, California) on 22 June 1995 (n = 2 males, SSL12 and SSL13) and 17 June 1999 (n = 1 female, SSL15). After 10 months in captivity, a satellite-lined time-depth recorder was attached to the dorsal fur of each sea lion to examine their movements, diving behaviors, and survival after release. transmissions were received for 1, 4, and 3 months for SSL12, SSL13, and SSL15,

respectively. Overall, diving behaviors of the 3 sea lions, including mean dive depth ($\bar{x}$ = 22.60 m, SD = 6.423) and duration ($\bar{x}$ = 1.13 min, SD = 0.40) were similar to those reported in the literature for free-ranging Steller sea lions. This study provided an opportunity to observe the performance of naïve, weaned, captive-reared individuals introduced back into the environment. To ascertain whether rehabilitation would be an additional option for the conservation of this species in the future, long-term studies need to be conducted to determine whether released sea lions survive and eventually reproduce.

Landscape Responses of Bats to Habitat Fragmentation in Atlantic Forest of Paraguay

by P. M. Gorresen and M. R. Willig
J. Mammalogy 85(4): 688–97

Understanding effects of habitat loss and fragmentation on populations or communities is critical to effective conservation and restoration. This is particularly important for bats because they provide vital services to ecosystems via pollination and seed dispersal, especially in tropical and subtropical habitats. Based on more than 1000 h of survey during a 15-month period, the authors quantified species abundances and community structure of phyllostomid bats at 14 sites in a 3000-km^2 region of eastern Paraguay. Abundance was highest for (*Artibeus lituratus*) in deforested landscapes and for (*Chrotopterus auritus*) in forested habitats. In contrast, (*Artibeus fimbriatus*), (*Carollia perspicillata*), (*Glossophaga soricina*), (*Platyrrhinus lineatus*), (*Pygoderma bilabiatum*), (*Sturnira lilium*), and attained highest abundance in moderately fragmented forest landscapes. Forest cover, patch size, and patch density frequently were associated with abundance of species. At the community level, species richness was highest in partly deforested landscapes, whereas evenness was greatest in forested habitat. In general, the highest diversity of bats occurred in landscapes comprising moderately fragmented forest habitat. This underscores the importance of remnant habitat patches to conservation strategies. *[©2004 Am. Society of Mammalogists]*



STELLER SEA LION AND PUP (*EUMETOPIAS JUBATUS*) PHOTO: USFWS

CONSERVATION

Red Imported Fire Ant Impacts on Wildlife: A Decade of Research

by C. R. Allen, D. M. Epperson, and A. S. Garmestani
Am. Midland Naturalist 152(1): 88–103

The negative impacts of biological invasion are economically and ecologically significant and, while incompletely quantified, they are clearly substantial. Ants (family Formicidae) are an important, although often overlooked, component of many terrestrial ecosystems. Six species of ants are especially striking in their global ability to invade, and their impacts. This paper focuses on the impacts of the most destructive of those species, the red imported fire ant (*Solenopsis invicta*), and focuses on impacts on native vertebrates. Red imported fire ants often become the dominant ant species in infested areas outside of their native range due to their aggressive foraging behavior, high reproductive capability, and lack of predators and/or other strong competitors. The evidence suggests that mammals, birds, and herpetofauna are vulnerable to negative impacts from fire ants, and some species are more likely to experience negative population-level impacts than other species. Assessing the ecological impacts of fire ants on wild animal populations is logistically difficult, and very few studies have combined replicated experimental manipulation with adequate spatial (>10 ha) and temporal (>1 y) scale. However, significant research, including an increase in experimental and mechanistic investigations, has occurred during the past decade, and this has led to information that can lead to better management of potentially affected species. *(©2004 University of Notre Dame)*

Tigers and Their Prey: Predicting Carnivore Densities from Prey Abundance

by K. U. Karanth, J. D. Nichols, N. S. Kumar, W. A. Link, and J. E. Hines
Proceedings of the National Academy of Sciences of the USA 101(14):4854–58

The goal of ecology is to understand interactions that determine the distribution and abundance of organisms. In principle, ecologists should be able to identify a small number of limiting resources for a species of interest, estimate densities of these resources at different locations across the landscape, and then use these estimates to predict the density of the focal species at these locations. In practice, however, development of functional relationships between abundances of species and their resources has proven extremely difficult, and examples of such predictive ability are very rare. Ecological studies of prey requirements of tigers (*Panthera tigris*) led the authors to develop a simple mechanistic model for predicting tiger density as a function of prey density. The authors tested their model using data from a landscape-scale long-term (1995–2003) field study that estimated tiger and prey densities in 11 ecologically diverse sites across India. The authors used field techniques and analytical methods that specifically addressed sampling and detectability, two issues that frequently present problems in macroecological studies of animal populations. Estimated densities of ungulate prey ranged 5.3–63.8 animals/km^2. Estimated tiger densities (3.2–16.8 tigers/100 km^2) were reasonably consistent with model predictions. The results provide evidence of a functional relationship between abundances of large carnivores and their prey under a wide range of ecological conditions. In addition to generating important insights into carnivore ecology and conservation, the study provides a potentially useful model for the rigorous conduct of macroecological science.

Forester's Log

CUTTING THROUGH THE TANGLE OF PRIVATE TIMBER SALES

by Mary Stuever

Recently some friends asked me to help them with a timber sale. I had assisted with some logging on their property in the late 1980s. The opportunity to work on the same piece of land two "cutting cycles" in a row is a forester's dream. I felt honored they included me in the action. I knew my worth when I took a look at a proposed Forest Harvest Practice Plan given them by one of the mills bidding on their timber. The cutting prescriptions were completely counter to my clients' objectives. Fortunately, they knew to bring in a professional forester, but I shudder to think how many other private timber sales have occurred under the "boiler plate" format that plan proposed.

First, let me go on the record: I like logging. Although that may shock the people who know of my passion for trees, I see logging as a tool we can use to achieve healthier forests. As a forester, I use logging to carefully sculpt the forest into better habitat for wildlife, a safer place for residents, and a more vigorous environment for trees. However, applying logging as a tool for improving forest health takes humility—a willingness to be particularly observant of the results, to admit mistakes, and to adjust future actions based on these lessons. Each time a forest is logged, there is opportunity to make the forest an overall healthier ecosystem. Thus the chance for a forester to work on the same property two cutting cycles in a row creates the opportunity to apply lessons learned and make that landscape resonate.

My clients' main reason for cutting trees is to improve their forests' resistance to catastrophic wildfires. They have lived in the mountains all of their lives. They are concerned with recent drought conditions and their growing awareness that the density of trees in the forest is not "natural" and leads to catastrophic fire behavior. Since they have actively managed their forests over the years through thinning and previous timber sales, many of the trees on their property are large enough to be "commercial." In their case, logging is a viable tool for thinning their forests.

The economic incentives of logging make the tool work, but they are not what should drive a timber sale. The logger or mill may want to log an area in the most efficient method to maximize their profit. The forester, representing the landowner, wants to have an area logged in a method that leaves the remaining forest in better condition than before the logging. This difference in purpose can lead to very different actions on the ground.

In New Mexico, private landowners cutting commercial timber on 25 acres or more in a calendar year are required to get an approved harvest permit from the State Forestry Division. The landowner is required to submit a written plan detailing the land management objectives and the methods of harvest that will be used to meet those objectives. In this case, the soliciting sawmill proposed a plan that would maximize dollars, but minimize the opportunity to meet my clients' objectives.

For example, one cutting prescription described a forest that is "primarily second-growth ponderosa pine with a few larger mature trees." Their plan suggests, "Removal of the larger, mature trees will reduce the fire danger." Actually, the small trees are the more imminent threat in wildfire situations. Older, larger ponderosa pines have thicker bark to resist fire damage. Their branches are generally well above the forest floor and do not offer the same fuel ladders as branches of smaller trees that can turn low intensity surface fires into raging crown fires. Cutting the larger mature trees and leaving the young, denser second-growth will only add extra slash to an already volatile situation.

For another tract, the mill's proposed plan suggests "thinning from above" which is a euphemism for taking the larger trees. The line I thought was most atrocious from this faulted plan followed a description of a timbered area where ponderosa pine is scattered and small. Their suggestion was, "In this area removal will be limited to the oldest and most accessible."

My clients also need to consider other concerns. With years of accumulated drought effects, we are posed for a major bark beetle outbreak in the pine. Since timber slash provides an excellent breeding ground for bark beetles, typical slash treatments may not be adequate this year to control such risks.

Timber harvesting will be a good tool to improve my clients' forest conditions, if we can find the right operator willing to put forest health as the first priority. At least we know what company we do not want cutting their trees. JWR

Mary Stuever is a consulting forester specializing in forest ecosystems of the American Southwest. She can be reached at sse@nmia.com.



JANELLE HARDEN

The Log from the Sea of Cortez

by John Steinbeck

with an Introduction by Richard Astro

New York: Penguin Books, 1995; 288 pages; U.S.$13.95 (paperback)
ISBN: 0-14-018744-8

Reviewed by Elsa C. Bumstead

"A tide pool has been called a world under a rock, and so it might be said of navigation, 'It is the world within the horizon'."
—Lyall Watson

Expedition time. Early John Steinbeck. *Tortilla Flat* (1935), *Of Mice and Men* (1937), and *The Grapes of Wrath* (1939) have been published. *Cannery Row* (1945) and *East of Eden* (1951) are yet to come. Put yourself on a sardine boat in 1940 and sail down the California coast with Steinbeck and biologist Ed Ricketts on a marine collecting trip. A word about Ed Ricketts: Raised in Salinas, Steinbeck spent a lot of time along the coast and got to know Ricketts from his days in Monterey. The *Log* begins—or ends, depending on which edition you read—with a wonderful character study of the marine biologist, who becomes the model for the character, Doc, in *Cannery Row*.

The trip begins in Monterey in pre-WW II California. A sardine boat named the *Western Flyer* is secured for the voyage. A motorized skiff, the *Sea Cow*, is brought aboard to be used to make excursions from the larger boat. The crew later learns that the *Sea Cow* would run perfectly out of water, but not in it. Boat, skiff, and crew become the characters in a wonderful journey that takes place in March and April of 1940. The course is south along the California coast to Baja, around the toe into the Sea of Cortez (also known as the Gulf of Baja), in and out of various Mexican ports of call, and in and out of various tide pools, flats, and coral reefs. Collections are conducted during daylight hours and at night by flashlight. Feeding behaviors of various species are noted. These are snapshots in time of a world that no longer exists, of distributions of species that likely have changed. What an adventure it would be to take this *Log* and re-create the route, sampling along the way in the same areas, to see if today's observations are similar or different than those that were recorded more than 60 years ago.

The imagery is vivid. Steinbeck's prose puts you right there, sailing, heaving to for the night, going ashore to collect, then sailing to the next station, preserving specimens, labeling containers, and taking stock of all the creatures collected in various habitats. There are spiny lobsters, sea urchins, starfish, sunstars, brittle starts, puffer fish, chitons, snails, tunicates, flatworms, shrimp, hydroids, sea fans, limpets, sponges, isopods, and sea anemones. Sally Lightfoot crabs dance. Swordfish leap, giant manta rays glide, and Eurythoe worms sting. Steinbeck ruminates here and there, revealing philosophical insights about a range of things, from taking the life of a sea turtle to protection of the willow grouse in Norway, discoursing on hawk extermination. At times he strays into the world of spirituality—of apparitions, saints, and werewolves, and of "burned" places hostile to animal and human life. Of the "burned" places, Steinbeck writes, "It is as though they were already inhabited by another and invisible species which resented humans," and wonders if a "mild radio-activity" is responsible.

The people of Mexico are unforgettable, from customs officers who greet "a fishing boat with the same serious ceremony they would afford the *Queen Mary*," to the locals who frequent the village cantinas, and indigenous Indians with their different sense of "time world." There's a trip inland to hunt for the bighorn sheep in the Sonoran desert, a fruitless venture in one sense, and fruitful in another. No sheep is caught, but the collection of horsehair worms from a little freshwater pool is a prize. Steinbeck wonders how they got there, "so far from other water. It seemed to us that life in every form is incipiently everywhere waiting for a chance to take root and start reproducing; eggs, spores, seeds, bacilli—everywhere. Let a raindrop fall and it is crowded with the waiting life."

From the story-telling to descriptions of sea life loaded with vitality and the wonders of the xeriphytic countryside, Steinbeck's narrative is a gem of an account of a marine expedition that recalls the spirit of Darwin's explorations aboard the *Beagle* in the 1800s. For those who would prefer to read a more in-depth account, the recommendation is to seek the full record of the voyage, pictures, log, and lists in your local library. The book originally was published in 1941 as the *Sea of Cortez: A Leisurely Journal of Travel and Research* by John Steinbeck and Edward F. Ricketts. In 1951 Viking Press published the narrative portion separately from the *Journal*, and it is the *Log* that has been reprinted in paperback a number of times since then.

Whichever one you choose to read, you see the renowned novelist become a serious student of marine biology before your very eyes. It's a sailing adventure not to be missed. JWR

Reviewer Elsa C. Bumstead is an interpretive naturalist, writer, environmental scientist, and sometime wildlife rehabilitator who is based in Albuquerque, New Mexico.

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

Wild Minds:
What Animals Really Think

by Marc D. Hauser

New York: Owl Books, 2001; 336 pp;
U.S.$15 (paperback)
ISBN: 0-8050-5670-X

The Third Chimpanzee:
The Evolution and Future of the Human Animal

by Jared Diamond

New York: HarperCollins, 1992;
416 pp; U.S. $15 (paperback)
ISBN: 0-0609-8403-1

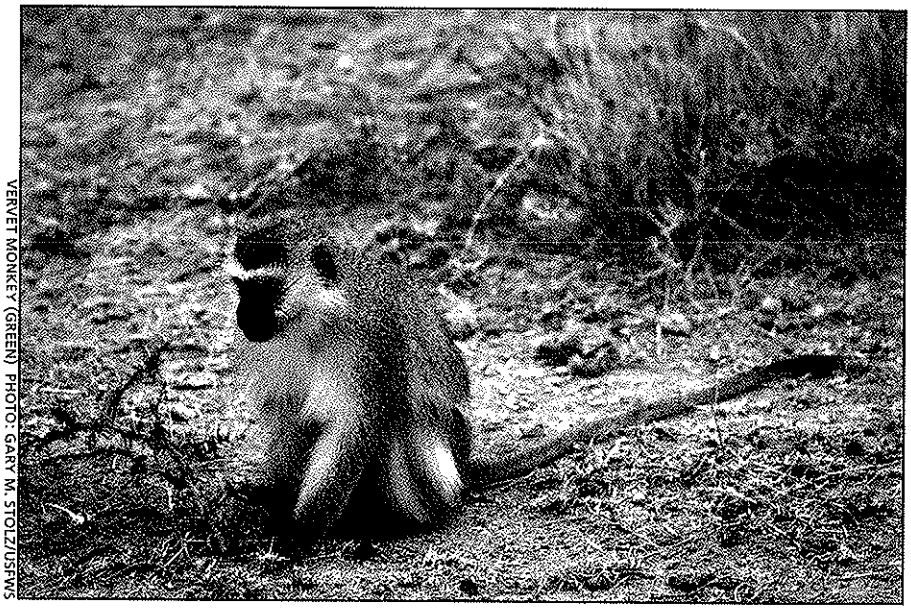
One of the differences between rehabilitators and wildlife biologists is that rehabbers care for and about individual wild animals, while biologists usually concentrate on understanding and protecting species. One danger for those biologists who don't actually work with animals is that they can drift away from life's complexities. A danger for rehabbers, on the other hand, is that we so easily interpret familiar-looking behaviors in light of our own thoughts and feelings. We do that with our companion animals all the time, and most of us have fallen, at one time or another, into the same pattern with our patients. We're undoubtedly more helpful to them when we don't. If we have a good idea how other animals really respond to what's going on around them, we'll better understand elements of stress, for example, and we might be able to form meaningful connections that can further the rehabilitation process.

So how can we learn to think clearly about what other animals experience? Unfortunately, many writers who report on animal behavior fall into the same traps we do. Take the notion that lions and black bears kill the offspring of other males "to insure that their own genes get passed on." Lions and bears do indeed kill cubs and mate with their mothers. But do genes influence motive? David Attenborough, in his wonderful BBC program *The Life of Birds*, filmed a male hedge sparrow pecking the cloacal opening of a female until she expelled sperm, probably of a second male, from her genital passage. He then mated with her, "after insuring that he was the one who fertilized her eggs." Attenborough also filmed coots pecking to death one of their brood, and a biologist explaining that the parents were over-stressed by a poor food supply and a large brood, and so sacrificed a weaker youngling. The motives assigned these enigmatic behaviors are speculative and seem to encourage us to interpret other creatures in light of human intent. Speculation can be great fun, but it doesn't answer questions solidly.

The Third Chimpanzee and *Wild Minds* both approach the evolution of thought and behavior with refreshingly solid evidence. In *The Third Chimpanzee*, Jared Diamond, a professor of psychology at UCLA Medical School, concentrates on human behaviors he believes are traceable to other species. Opinion? Yes, but founded on research literature. In *Wild Minds*, Marc Hauser, a professor in Harvard's Mind, Brain, and Behavior Program, looks at recent studies on how both human infants and other animals formulate and solve problems. He is scrupulously careful not to embroider on observation. Perhaps that's why he avoids the genetic-imperative question. I found myself wishing he would weigh in on it, because of the marvelous clarification he brings to other tangled issues. His chapter "Moral Instincts" is a model of clear thinking.

Hauser's subtitle, "What Animals Really Think," is somewhat misleading. He admits that we do not and possibly can never know exactly what a member of another species is thinking, because our mental constructions are often so different. His thesis is that while all animals, including humans, share a "universal mental toolkit" based on certain instinctive behaviors and physiological apparatuses, each species has its own exquisitely honed set necessary for survival in its niche and for evolving successful behaviors in the face of social and environmental pressures.

Other animals think quite effectively, he concludes, but they do not think like humans. "Do our pets," he asks in the Prologue, "really feel anxious, happy, guilty, and sad the way we do, or are their facial and bodily expressions simply good copies of what we do without the underlying feeling? When animals find their way home in the dark, are they simply following a trail of odors, or do they refer to a map digitized inside their brain? When animals communicate, are their minds filled with symbols, or are their grunts, coos, and screams the uncontrollable eruptions of passions? Do animals simply follow rules, or do they know...why some actions are right and wrong?"



VERVET MONKEY (GREEN) PHOTO: GARY M. STOLZ/USFWS

Several good research studies examine these questions, and Hauser discusses them at length. Cheney and Seyfarth's work with vervet monkeys (*How Monkeys See the World*), for example, defines distinct danger signals vervets give for three different predators: eagles, leopards, and snakes. The authors make it clear that this information is understood and used by other members of the troop. In one instance, a young vervet who makes a mistaken call is punished by its mother. But it is not clear, Hauser points out, that communication was actually the intent of the signaler. Again and again, Hauser heads off our tendency to see in animal actions the reflection of our own experience. He also points out where studies fall short of answering his questions, and suggests areas that need further work. Students of animal behavior could plan a lifetime of research just by reading this book.

Hauser avoids identifying adult human behavior with that of other animals because "Given that humans diverged from their chimpanzee-like ancestors five to six million years ago, it is possible for us to have evolved capacities that other animals lack." Diamond does exactly the opposite. Humans are "Just Another Species of Big Animal" (section title)—even our defining behaviors, Diamond believes, can be traced to elements in other species. He takes us on an intricate journey through our development, linking us to other species all along the way. In other words, he shows us how we are like them, not how they are like us.

In the process, he compares modern humans with Neanderthals, and humans with the two chimpanzee species. (We share all but 0.6 percent of our DNA with both, and are therefore the "third chimpanzee.") He develops interesting explanations for how we came to our specific sexual behaviors (different from those of the other chimpanzees); why we age and die (apparently the body could develop chemical means of self-repair so that we, in essence, could live forever); what we have done with language; how early agriculture was the first step toward the devastation of our habitat; why we smoke, drink, and use dangerous drugs. Finally, why we indulge in murder and war.

I can't resist an anecdote that highlights the theses of these books. It came from neither, but from a professor of biology at Sacramento State College, during a marvelous talk on insects. He was asked by a member of the audience whether insects—indeed, any other animal—*learned*. "I'm not sure," he replied. But someone had told him a good story that addressed the question: Jane Goodall used to put out bananas for the Gombe chimpanzees and observe their behavior. When the chimps got used to the handouts, there'd be a wild free-for-all every time she opened the box (which she did remotely). So she began leaving the box closed until only a couple of chimps were near it. One old male apparently caught on to this, and he'd lead the others away from the box. When he had them deep in the woods, he'd hide and then run back to the box. It would open. And he'd scream with delight and grab as many bananas as he could carry.

After several such "tricks," the other chimps wised up and when he'd try to lead them away, they'd rush to the box. But it wouldn't open because there were too many of them, so eventually they'd wander away. Only the old male waited and when he was alone, the box would open. Goodall has pointed out that chimps cannot control their emotional vocalizations. So when the box opened, he couldn't help but scream. But now he clapped his hands over his mouth to muffle his cries. And so once more got the bananas.

Thinking, planning, learning? How tempting just to say: "Yes!" And Diamond probably would, seeing here the template for more complex human activities. Hauser, on the other hand, would surely define points of unbridgeable distance.

Both, different as they are, will take you beyond your assumptions.

Diamond's book is more speculative than Hauser's, and in that sense more fun. He'll make you look at your own behavior with new eyes. At times he gets a little sloppy, falling into the trap, for instance, of taking the then-current (1992) archeological record as fixed, although new discoveries are constantly changing the picture. And he says at one point that golden eagles in "Mongolia" have been known to kill their human handlers. I've found no record of an eagle's actually killing an adult human, and Diamond gives no reference.

Hauser is more careful. I suspect that, in the final analysis, he is deeper. He will send you back again and again to study and argue through the subtle passages of his book. And to examine and re-examine your own experiences with other species.

It is good—and important—for us to recognize kinship. But it's also important to remember that no animal is diminished by being different from us. JWR

Reviewer Sallie Reynolds is a rehabilitator with Sierra Wildlife Rescue in Placerville, California.

The Beak of the Finch: A Story of Evolution in Our Time

by Jonathan Weiner

New York: Vintage Books, 1995;
332 pp; U.S.$14
ISBN 0-679-40003-6

The Beak of the Finch is an amazing book that I borrowed from one of my volunteers after a discussion in an education team meeting on how best to address "evolution" in our programs. Jonathan Weiner is a former editor and writer for *The Sciences* and, as one of the reviews quoted inside the cover says, he is a "science writer who makes complex research accessible to the ordinary person, and he does so with wit and style." *The Beak of the Finch* won the 1995 Pulitzer Prize for nonfiction books and the *Los Angeles Times* Book Prize.

This fascinating book ties together Darwin's original theory of evolution with research being conducted today, both focusing on the Galapagos finches so central to Darwin's original premises. At the core of the book are two scientists, Peter and Rosemary Grant, who have been studying the finches on a desert island in the Galapagos for 20 years. Weiner chronicles their findings and brings in other current research that show that evolution is not necessarily something that occurs slowly over time, so slowly that we originally thought it could not be observed. It is something going on all around us, as he so lyrically describes.

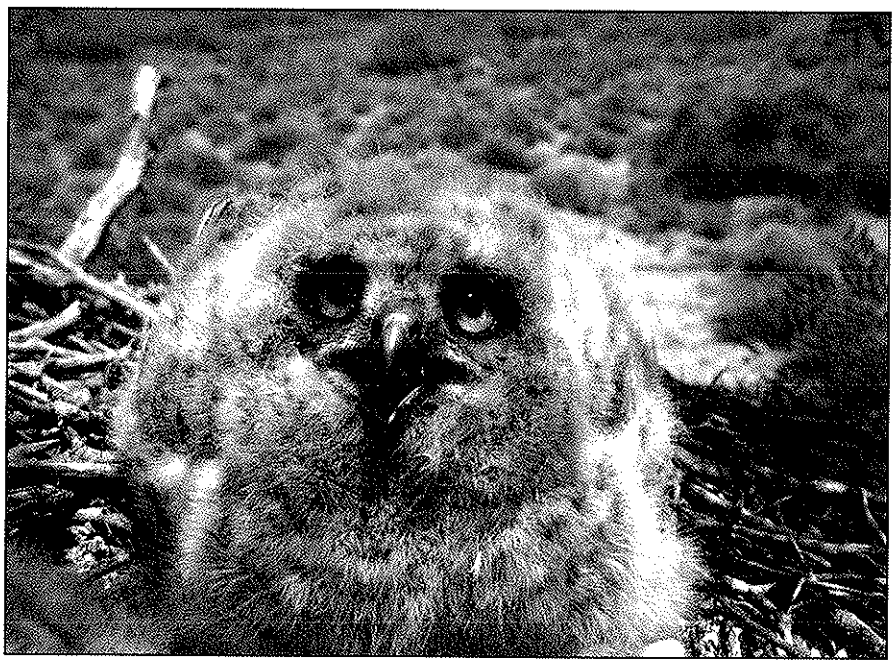
> "Most of us think of the pressures of life in the wild as being almost static. Robins sing in an oak tree year after year. We imagine that life puts more or less the same pressures year after year on the robin and the oak. But the lives of Darwin's finches suggest that this conception of nature is false. Selection pressures may oscillate violently within the lifetimes of most of the animals and plants around us, so that the robin must cling to the oak, and the oak to the ground, in chafing and contrary winds. It is as if each living thing on earth is holding on at the very shore of an ocean, in rough and invisible seas, swaying in place as each wave shoves it toward the shore and then tottering as the broken surf drags it back again."

In our field, we've noticed the adaptive value of the coloration differences between great horned owls in the far north (nearly white), in the arid interior west (sandy colored), in the mixed deciduous forests of the east (more red), and the coniferous forests of the Pacific Northwest (very dark). We've noticed the bare feet of barred owls in the southeast vs. the feathered feet of the barred owls that have now reached the West Coast after extending their range north and across Canada. One wonders if their feet will again go bare as the population reaches the Southwest. But even that is slow compared to the annual changes that can be brought about by weather and food availability cycles, as detailed in this book. On Daphne Major, a mere speck of rock even among the Galapagos Islands, a perfect laboratory allows every single finch to be identified and observed across generations, and the cataloging of which species best survive the various environmental conditions thrown at them by El Niño, La Niña, and weather inbetween. Which seeds do best in which conditions determines which finch species waxes and which wanes. Over time, this ebbing and flowing has produced the radiation of species first seen by Darwin on his voyage. But they are not as static as was once thought.

> "If we look at the billowing smoke of a volcano from close up, we see intense and rapid motion, enormous and dangerous turbulence. If we look at the eruption from far, far away (a safe distance that puts it almost to the horizon), the smoke seems to hang in the air almost motionless: we have to watch a long while to see any change at all. The evolution of life turns out to be rather like the eruption of a volcano. The closer you look, the more turbulent and dangerous the action; the farther your remove, the more the living world seems fixed and stable, hardly moving at all.
>
> "It is amazing to think of all these species around us not fixed but in jittery motion. It is like the difference between the old view of solid physical matter around us —the view in the time of Newton—and the view now, of infinite motion down to the level of each atom and molecule, and below, in the ceaseless assault and battery of elemental particles. The beak of the finch is an icon of evolution the way the Bohr atom is an icon of modern physics, and the study of either one shows us more primal energy and eternal change than our minds are built to take in. Yet like the vista of the atoms, the vista of evolution in action, of evolution in the flesh, has enormous implications for our sense of reality, of what life is, and also for our sense of power, of what we do with life."

I feel strongly that this book is a must-read for anyone doing environmental education, for anyone working with wildlife, or for anyone simply observing and appreciating nature. Beautifully written and presented, this book touches on pesticides and AIDS research, fish and antibiotic-resistant bacteria, as well as the central theme of Darwin's finches. I could barely put it down and read it cover to cover in about a day and a half! IWR

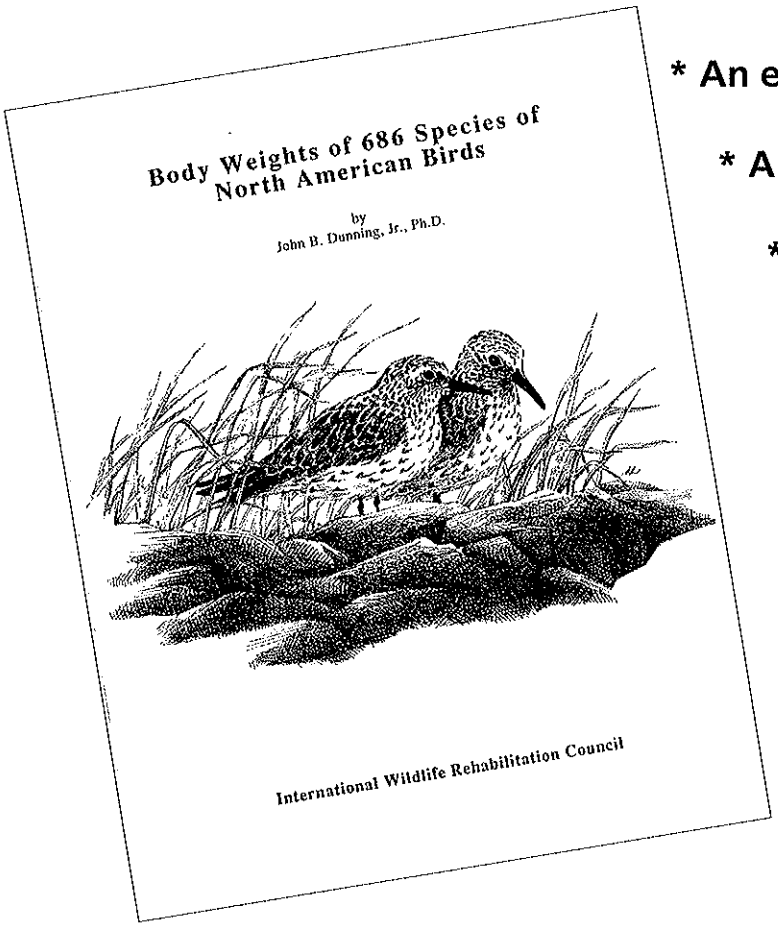
Reviewer Louise A Shimmel is director of the Cascades Raptor Center in Eugene, Oregon.



GREAT HORNED OWL (3 WEEKS OLD) PHOTO: GARY M. STOLZ/USFWS

Editor's Note: *The* Journal of Wildlife Rehabilitation *welcomes reviews of books of interest to IWRC members, including veterinary reference books, memoris, natural history, and novels. Please include the book's title and author, as well as publisher, date of publication, number of pages, and cost of the book. Reviews should run no longer than 650–700 words and should be e-mailed to runmuki@yahoo.com.*

Available Exclusively from IWRC



*** An essential rehabilitation tool**

*** A handy reference manual**

*** Organized by species**

*** A great price!**

Body Weights of 686 Species of North American Birds

by John B. Dunning Jr, Ph.D.

Knowing the normal weight of an animal is essential when assessing body condition. Dr. Dunning has kindly allowed IWRC to reprint this monograph, originally published by the Western Bird Banding Association. Standard and normal ranges are provided by species. An invaluable resource tool for anyone who works with birds. **Just $10 (plus shipping and handling).**

Please contact IWRC for an order form and a complete catalog of our publications.

International Wildlife Rehabilitation Council
8080 Capwell Drive, Suite 240
Oakland, CA 94621
USA
Tel: 510/383-9090 Fax: 510/383-9094

IWRC accepts Mastercard, Visa, and Discover.

United States Is Major Ivory Market

A new report has found that 15 years after the CITES global ban on elephant ivory trade went into effect, the United States remains a major market for ivory.

The report is based on investigations of both legal and illegal ivory markets by TRAFFIC, the wildlife trade monitoring network of the World Wildlife Fund.

TRAFFIC investigators examined U.S. government seizure records for ivory, researched the domestic ivory market, and posed as prospective ivory buyers online to learn about the ease with which ivory dealers get their goods into the country.

The U.S. has the highest rate of ivory seizures in the world, and much of the ivory caught at the borders in small quantities is brought into the country by individual consumers, often as souvenirs, jewelry and carvings. In addition, the growth of the Internet has created a new channel for the ivory trade.

The report indicates that while progress is being made in China–the world's largest ivory market–demand in Africa and other parts of Asia is driving an increase in the illegal trade of ivory and the poaching of elephants.

At least 4000 elephants are killed each year to meet the global demand for elephant ivory, which is used to make carvings, jewelry, and other products.

The report is available at www.traffic.org /news/press-releases/ivory_markets_usa.html.

JWR

Species Diversity Decreasing in Britain

Two studies of plants, birds, and butterflies offer comprehensive evidence that species diversity is decreasing in the United Kingdom. Results varied for individual species, however, each group of organisms showed some overall declines. The findings support the hypothesis that the world is experiencing a mass extinction on par with five earlier mass extinctions that have punctuated the Earth's history.

This hypothesis previously rested on data representing a relatively small portion of the world's plants and animals. Population information about insects, which make up approximately 50% of all known species, has been particularly sparse.

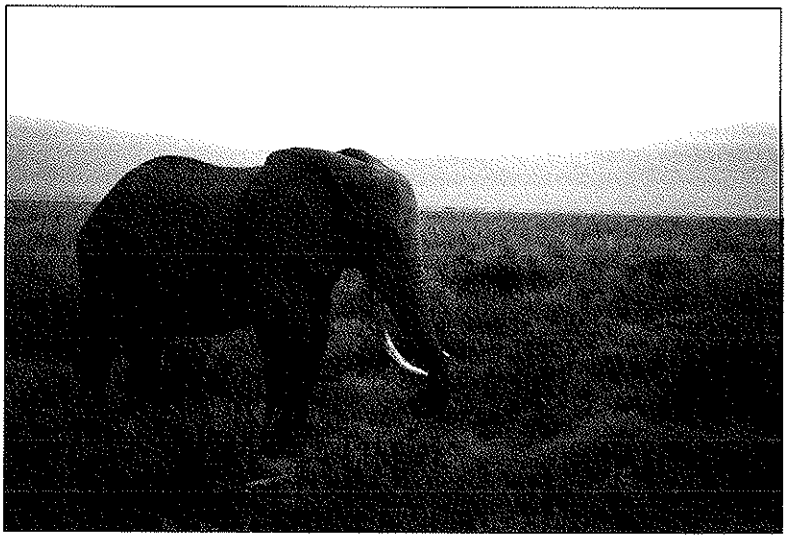
"It strengthens the case for those arguing for policies nationally and globally to mitigate the effects that man is having on the environment," noted lead researcher J. A. Thomas.

A second report implicates nitrogen pollution as the most likely reason for reduced grassland species richness in parts of the United Kingdom, and possibly elsewhere in Europe.

Excess nitrogen can allow a few species, especially grasses, to grow fast and crowd or shade out their neighbors. The nitrogen is deposited from the atmosphere as the result of agricultural fertilization and fossil fuel combustion.

The studies were published in the magazine *Science* (www.sciencemag.org).

JWR



AFRICAN ELEPHANT (LOXODONTA AFRICANA) PHOTO: GARY M. STOLZ

International Wildlife Rehabilitation Council

INCOME & EXPENSE STATEMENT (UNAUDITED)

For the year ending 31 December 2003

REVENUES

Bequests	$ 10,000
Donations	27,965
Annual conference	3,002
Training & seminars	66,034
Membership dues	62,516
Literature sales	6,940
Miscellaneous revenues	1,198
Total Revenues	**$177,655**

EXPENSES

Annual conference	$19,269
Training & seminars	19,910
Postage and printing	21,461
Insurance	5,002
Supplies	5,278
Rent & utilities	13,111
Staff & contract employees	94,347
Website	1,116
Professional services	5,222
Miscellaneous revenues	5,746
Total Expenses	**$190,341**
Profit (Loss)	**($ 12,686)**

DITTO A REPRODUCIBLE PUBLIC SERVICE ANNOUNCEMENT

IN BEAR COUNTRY...

black bears are always in search of food

If you and bear are neighbors, keep the fragrant stuff far away from your house. When bears find food around homes, they teach their children to forage there. Then your home becomes unsafe for people or bears. Keep in mind: the only bear hungrier than the bear getting fat for a long hibernation is the bear who has just awakened from a long hibernation.

What smells like food *is* food: grease on the grill, dog and cat food, bee hives, bird feeders, hummingbird feeders, fruit on or under trees, compost piles, chicken pens, woodpiles (attract insects and rodents), bones;, milk cartons, leftovers, garbage.

Visiting Bear Country

Hike in groups, make noise (wear bells), and keep pets and children close. A surprised bear is a dangerous bear.

Pack food in, pack containers out. Don't trash-attract bear to the trail.

When camping...

Cook 100 yards from where you sleep. Change clothes after cooking/eating and before sleeping.

What smells like food is food to bear: toothpaste, soap, granola bars, chocolate, insect repellant, cooking smoke, dishwater (strain particles and pack out).

Store all food-related items in hard-shell, sealed vehicle or hang it high—4 feet from the trunk of a tree and 10 feet high—and 100 yards from where you sleep.

If you meet a bear: Stand tall. Keep talking. Extend and slowly wave arms. Back away slowly; watch for cubs and move away from them. If attacked, fight aggressively.



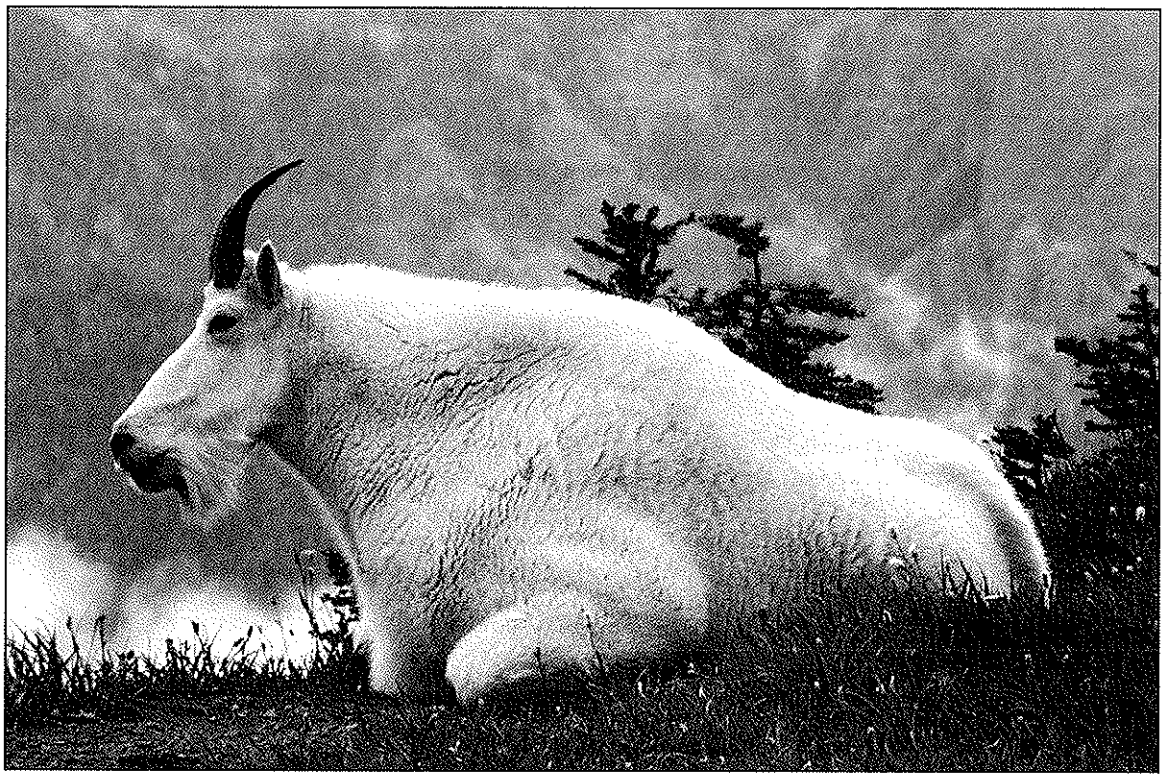
Contact the Center for Wildlife Information for further material and a 24-page coloring book for young hikers/campers:

PO Box 8289, Missoula, MT 59807
406/523-7750)

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

TAIL END

by Kieran Lindsey



MOUNTAIN GOAT PHOTO: DAVE GRICKSON/USFWS

"The hills are alive...with the sound of music!"

INSTRUCTIONS FOR AUTHORS

POLICY Original manuscripts concerning any aspect of wildlife rehabilitation are welcome. Articles on topics including administration, law, education, veterinary medicine, animal husbandry, and public relations as they relate to wildlife rehabilitation are all invited. Book reviews are also welcome. Submissions are not confined to the North American continent.

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). IWRC retains copyright on all original articles published in JWR, but will grant permission to reprint articles upon request, with credit given to IWRC.

MANUSCRIPT Copy should be typewritten and double-spaced. Include the name of each author, addresses, phone numbers, e-mail addresses, a one-paragraph biography for each author, an abstract, and several keywords. Templates have been developed for the following categories of submissions: Species paper (i.e., rehabilitation notes), case study, technique, research paper, and review; authors may request a copy of one or all of these templates from the Editor or the IWRC office before developing work for submission in JWR.

SUBMISSIONS All submissions should be accompanied by a cover letter stating the intent of the author(s) to submit the manuscript exclusively for publication in JWR. Double space throughout, with one-inch margins. The author(s) should keep at least one copy of the manuscript.

ELECTRONIC SUBMISSIONS Electronic submissions (PC or Macintosh platforms) are preferred but not required. The manuscript should be attached to the submission letter and sent to ALL of the following:

Marianne Skoczek, Editor
runmuki@earthlink.net

Elizabeth Penn Elliston, Publications Committee Chair
epe@nmia.com

IWRC Office
office@iwrc-online.org

HARD COPY SUBMISSIONS In the top left corner of page 1, type the name and complete address, including e-mail, of the person who is to receive editorial correspondence. On succeeding pages, type the primary author's last name in the top left corner, and the page number in the top right corner. Use a good quality white paper and submit four good photocopies to:

Marianne Skoczek, Editor
Journal of Wildlife Rehabilitation
837 14th Street, San Francisco, CA 94114
USA

STYLE Citations should be noted within the body of the manuscript with the last name of the author and the year published (with one space between—no comma) using the following format: single author (Smith 1959); two authors (Smith and Jones 1979); more than two authors (Smith et al. 1989). A complete list of literature cited should be included at the end of the manuscript in alphabetical order, beginning with the last name of the first author. (Citations with more than two authors may list all authors names in the References section.) Please use sentence- style capitalization throughout the citation (mixed case). Provide complete citation information, including date; title; issue, volume, and page numbers of journal articles; and place of publication and publisher of books. Tables and illustrations must be self-explanatory and reference to them included in the text. The first use of a common species name should be followed by scientific names in parentheses (i.e., The appearance of the American robin (*Turdus migratorius)* does not always coincide with the beginning of spring.). Use metric units of measure followed by English/U.S. units in parentheses. If trade names are used, indicate if the product is trademarked or registered and list any products cited along with generic equivalents, when available, at the end of the article. Please provide full address (including zip code) of the product manufacturers.

ABSTRACT, KEYWORDS Manuscripts require an abstract of about one typed line per typed page of text. Place keywords below the abstract.

TABLES Start each table on a separate page and continue long tables onto two or more pages. Double-space throughout and leave margins of at least one inch. Annotate abbreviations.

PHOTOGRAPHS JWR publishes high-quality black and white photographs, as available. Color slides and prints are acceptable, however, all images will appear in black and white only. Type captions on a separate page, in paragraph form, along with photographer credits. Photos should be unmounted, sharply focused, and have a good tonal range. Electronic images should be medium or high resolution (minimum 300 ppi) and should be saved as .JPG or .TIFF files. To facilitate e-mailing, files should be saved as greyscales. Files should be e-mailed to the Editor at runmuki@earthlink.net. They may be compressed with StuffIt or a similar program.

ILLUSTRATIONS Illustrations should be clear and well defined, and should be drawn in black, grey, and white only. Illustrations may be submitted on paper or electronically as .EPS or .TIFF files. Please note whether the electronic illustration was created in Illustrator® or another program. Electronic files should be e-mailed to the Editor at runmuki@earthlink.net.

INTERNATIONAL WILDLIFE
REHABILITATION COUNCIL
(IWRC)
8080 Capwell Drive, Suite 240
Oakland, CA 94621, USA

NONPROFIT ORG.
U.S. POSTAGE
P A I D
JEFFERSON CITY, MO
PERMIT NO. 210