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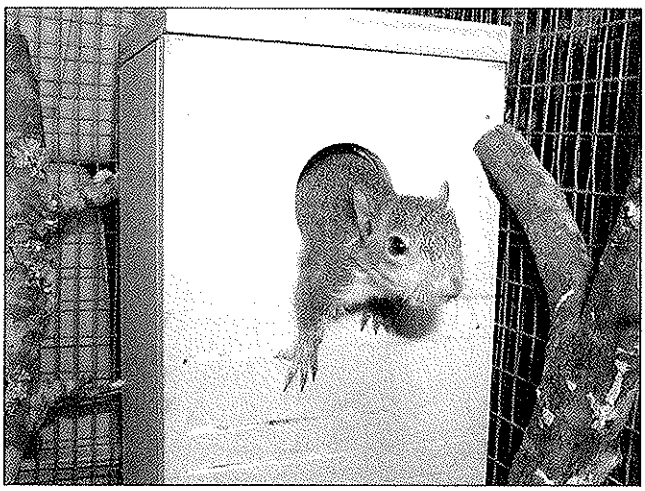
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Anthropogenic Causes of Avian Mortality ... An Improved Handrearing Diet for Hatchling and Nestling Columbids ... Campaign to Discourage Easter "Pets," and Raise Funds ... Building a Squirrel Box ... Environmental Despair ... Songbirds in the Home ... Book Reviews ... 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: Electric crews in Albuquerque, New Mexico, found this red-tailed hawk (*Accipiter jamaicensis*) under power lines. As the bird landed to eat, the coachwhip snake (*Masticophis flagellum*) may have draped across two power lines, acting as a ground; both animals were electrocuted. [PHOTO: R. W. Dickerman, Museum of Southwestern Biology, University of New Mexico]. BELOW: Providing a safe, temporary home for young squirrels. [PHOTO: Pat Issacs]



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FOR INFORMATION

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

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

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EDITORIAL

Standards, Oh My!

The idea of self-setting guidelines and standards in a field primarily of volunteers is perhaps a difficult one for some folks to grasp. We have no governing board that can dis-bar or de-frock or pull someone's permit to practice wildlife rehabilitation as do the legal, spiritual, and medical communities. What we do have are regulations that vary enormously from state to state or country to country, two different professional associations, and permit requirements laid out by the U.S. Fish & Wildlife Service for those in the U.S. working with migratory birds or threatened and endangered species. However, it was clear twenty years ago that if we didn't establish professional standards for ourselves, the regulatory agencies would do it for us.

In my opinion, the *Minimum Standards for Wildlife Rehabilitation*, 3rd edition, 2000, edited by Dr. Erica Miller is one of the most useful and far-reaching documents to come out in this field in a very long time. Useful both because of *what* it covers (way more than simply cage sizes) and because it truly represents the thoughts, experience, and practices of many different people. Anyone who had an opinion on any aspect of the previous edition was invited to submit that opinion—and it was reviewed by a large group of peers. And far-reaching because it is now referenced in U.S. Fish & Wildlife Service standard conditions and proposed to be referenced in the new subpart under Title 50 CFR 21 regulations as being the guidelines, at least for cage sizes, for rehabilitating birds; because many state wildlife agencies are also referencing it, for all species; and because it has been at least reviewed by other countries in consideration of their own regulations. Its being referenced in the Standard Conditions first attached to federal rehabilitation permits in 1998, in fact, is what gave rise to the most recent effort to update it.

All three editions of the Minimum Standards booklet were developed and published jointly by IWRC and NWRA. Starting in the 1980s, the organizations decided to bring together rehabilitators experienced with different species in order to combine that experience into a single document that would represent both solid standards of housing and care, and goals that would be attainable by rehabilitators. The standards committees of both organizations were reconvened in the early 1990s to fix some errors and oversights, and incorporate some changes. The original document and all revisions were approved separately by both boards.

Underlying the original effort in the 1980s was the fact that few states had detailed wildlife rehabilitation regulations and that it would thus fall to the national organizations (i.e., rehabilitators themselves) to self-regulate. Although NWRA fairly early on abandoned the idea of accreditation based on these standards, IWRC did initiate a pilot program in California, with funding from the state, to certify interested organizations. However, in the absence of funding, the costs of the program were high and the benefits of such a certification were not clear cut—especially as many state agencies did move to revise and improve their internal regulations as public awareness of wildlife rehabilitation rose. The Minimum Standards booklets included a self-check list for both centers and home care rehabilitators or out-shelter networks to assist them in evaluating their facilities, either in the simple desire to improve or in connection with a proposed accreditation.

Remembering that both national organizations share the mission of facilitating the continued improvement of wildlife rehabilitation, any rehabilitator dedicated to the care of wildlife, it seems to me, whether from a large center or a small home care facility (where most of the large centers started), has an interest in improved self-regulation.

And the best way to be sure you are represented in any process affecting your practice of wildlife rehabilitation is to share your input. Come to conferences, submit comments and opinions when the opportunity arises, share your experience! Our field is changing and growing in professionalism—the communication tools of e-mail and the Internet have made it possible for new information to reach all parts of the globe within minutes. We urge everyone to network on this level. The animals we serve can only benefit.

—Louise Shimmel
Board Member, IWRC
Director, Cascades Raptor Center,
Eugene, Oregon

On Pests and Cats, "Light" Foods, MacDiet

Certain birds, such as starlings and perhaps sparrows and pigeons, are considered pests and a threat to some of our native wildlife . They certainly are considered a problem by some people. Hawks have been reintroduced to keep control over these critters, but what about the cat? I know of a farm that had a great many cats to keep the rat and mice population down, and it was effective. Birds that are considered pests are excessive in numbers. I believe the cat is as necessary to their control as the hawk. I rehabilitate birds that are considered good or pest species. I pass no judgement. I rehabilitated two mallard ducks since they were chicks and released them three months later. I almost cried because I knew I was releasing them to possible destruction by a hawk. I felt like a parent to these ducks—but I also love the hawk. A rehabber has to be impartial and realistic. I hope my two mallards will never be killed, but I also hope that the hawk finds one if it is to survive, as long as it is not one of my mallards.

The writer raises a number of topics that seem to be related to the spaying of cats and the related issue of feral cat feeding programs. These are both legitimate, ongoing problems. The IWRC believes that responsible rehabilitators need to keep in mind the following:

1. Cats, as "pets gone wild," are still domestic animals and require the care and nurture of people to function best as they were bred (not "evolved") to do.

2. Feral cats overpopulate neighborhoods, leading to transmission of cat diseases and fighting with pets; depredation of all the small native prey available (birds, reptiles, and mammals); and starvation among the cats themselves. The cats are also subject to being preyed upon by other cats, coyotes, owls, and people. Spaying and neutering begins to address the problem of the growing feral cat population.

3. Cats choose prey that presents itself, not other "pest" species. "Pest," after all is in the mind of the beholder, and usually refers to the species in overabundance that brings itself to the attention of people.

—The Editors

I've heard that some people use "light" cat food in their nestling songbird food. They say that it "dilutes the fat" of other components in their mix. Is there any problem with using "light" cat food?

Yes, there is a problem. "Light" pet foods contain added cellulose from a plant source such as beet meal or even peanut shells. Cellulose is indigestible to cats, dogs, and songbirds. It is added to be filling but provides no calories.

One popular light food is comprised of 38.1% protein (some from corn), 31.5% carbohydrates, and 9.5% fat. Nearly two-thirds of the carbohydrates come from powdered cellulose.

Given that young birds do not have the ability to digest carbohydrates or cellulose, almost half of this food offers the birds nothing.

That is exactly the opposite of what young birds need. Nestling passerines require that every gram of their food be highly nutritious. Cellulose dilutes the nutritional value of the food and, if the light food is a significant fraction of the diet, it can interfere with the absorption of other nutrients. Because of the presence of corn and cellulose, this food contains approximately half the levels of protein and fat that birds require.

Nestling songbirds are true carnivores—they require an animal-based diet, just as kittens do. "Light" adult cat food is unsuitable for kittens, and they may not even be able to survive on it. Young songbirds require a diet of even higher quality than do kittens, since birds grow faster. The use of "light" food is essentially including shredded newspaper in the diet, and it is not in the best interest of either kittens or songbirds.

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

This summer, our center switched from a dog-food-based passerine nestling diet to MacDiet. We've been feeding the babies as we always have, but they sometimes have diarrhea. Are we doing something wrong?

Assuming that your hygienic practices are fine, you may be overfeeding MacDiet. Less nutritious diets have a lot of indigestible components (that are not "bioavailable"), and you may be used to filling the crop often because the birds are chronically hungry. It's similar to being on a diet of salad—you may eat a lot of it often and never feel satisfied. If you watch songbirds feed their young in the wild, they rarely fill the crop. Instead, relatively small meals of highly digestible food (insects) are fed. MacDiet approximates the bioavailability of insects, so smaller amounts should be fed, or the bird may develop diarrhea from overfeeding.

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

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. Those letters that seem most beneficial to the greatest number of readers will be included in our new Letters pages. (NOTE: Letters may be edited for clarity and length.)*

NEO-REHABILISMS...

lactated stringers
volunteers who have been milked dry

meatabolic bone disease
what results when you feed a BOP hamburger

paraslite
an insult to the immune system

An Overview of Anthropogenic Causes of Avian Mortality

by Janelle Harden

ABSTRACT: The natural world presents many survival risks to avian populations. Examination of 5 years of wildlife rehabilitation data from Wildlife Rescue, Inc. of New Mexico suggest that anthropogenic (human-caused) threats to avian survival are perhaps equally common; a review of the published literature confirms those suspicions. This study provides background on the most common types of human-caused avian mortality, along with specific examples of each.

KEY WORDS: anthropogenic, avian mortality, birds, commercial fishing, domestic predation, nontarget species, pesticides, tower strikes, window strikes

JANELLE HARDEN began rehabilitation in 1986 when she became a subpermittee under Wildlife Rescue, Inc. of New Mexico. A professional graphic artist and typographer for 30 years, she is now pursuing her undergraduate degree in the Department of Biology at the University of New Mexico, Albuquerque.

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Introduction

A wealth of published material indicates that much of the avian mortality around the globe can be attributed to human activities. A complete examination of the topic is beyond the scope of this paper, as any one of the four major categories of anthropogenic causes of avian mortality identified here easily could become the subject of an entire book. This study provides an introduction to the most common types of human-caused avian mortality and specific examples of each.

Methods

An examination of annual report data from Wildlife Rescue, Inc. of New Mexico (WRI) suggests that anthropogenic threats to avian survival may be more common than natural causes. Rehabilitation data, by the very nature of its collection, may be weighted toward anthropogenic causes. However, examination of the published literature confirmed that human-caused avian mortality is widespread and affects many millions of birds each year.

A review of the published literature from 1969 to 2000 was conducted using BIOSIS and SciSearch. The most common causes of avian mortality were identified and organized into four general categories: chemicals, collisions, commercial fishing, and domestic animals. A more specific search of the literature followed in order to identify representative cases to use as examples and to provide background on the issues surrounding each mortality category.

Background

The natural world presents many survival risks to avian populations. These include, but are not limited to, migratory mishaps, endemic diseases, natural predation, disturbances that lead to abandonment of nestlings, and climatic factors (e.g., inclement weather and cyclical disruptions such as El Niño).

Initial examination of 5 years of annual report data from WRI (Table 1) indicated that the majority of birds received by rehabilitators were admitted for care as the result of interaction with humans, directly or indirectly.

Forty-two (42)% of birds admitted to WRI are reported as "unknown cause." This is due, in part, to the fact that rehabilitators must depend on the finder for information. When asked, "Why do you think the bird was down?" the answer is frequently, "I don't know." In addition, many causes of avian mortality, including poisoning (direct or through biomagnification) and endemic diseases (i.e., salmonellosis in Fringillidae, trichomoniasis in Columbidae or their raptor predators, and avian cholera in waterfowl), are difficult to confirm, especially without access to laboratory equipment. Because of these factors, some categories presented may not reflect the true numbers involved.

Other causes of injury are obvious, (e.g., gunshot wounds, predator teeth marks, glue from sticky traps, and so forth). Often, the circumstances under which a bird is found reveal a great deal about the cause of mortality. Birds found in or on a roadside are likely to have collided with a vehicle; extensive impact injury such as neurological disorder(s) can provide confirmation. Birds found under a window are also probably strike victims. Birds found under power lines are likely to have experienced line-associated injuries. This review of the literature supports WRI findings and indicates that, around the world, great numbers of birds are killed annually by a variety of anthropogenic causes. Clearly, avian populations are seriously threatened by human activities.

Discussion

Anthropogenic causes of avian mortality have been organized into four discrete categories: chemicals, collisions, commercial fishing, and domestic animals. Some of the categories included here were divided into subcategories for further examina-

tion. Topics left for another time include habitat destruction, toxic diatom blooms caused by contamination of waterways, the impact of fire ants, hunting, poaching, and legal scientific collecting.

Chemicals

For the purposes of this review, chemical causes of avian mortality include both pesticide use and contamination from mining and industrial activities. Of the two, problems related to pesticide use have a higher public profile (e.g., Rachel Carson's famous 1962 book, *Silent Spring*). Research on the nontarget hazards of pesticides have resulted in some regulatory attention, at least in the United States. A ban on DDT (dichloro-diphenyl-trichloroethane), the chemical once touted as key to eradicating malaria, was achieved. However, as quickly as "pesticides" are proved dangerous to nontarget species, and their use is brought under control, other innovative humans create new toxic molecules. Industrial and mining activities are also cause for concern. Mishaps such as the *Exxon-Valdez* oil spill in 1989 may garner worldwide attention, but in general the mainstream public remains ignorant of the environmental effects of mining and industrial activities.

Pesticides

Most modern pesticides fall into one of two large groups of chemicals: chlorinated hydrocarbons and organophosphates. The Smithsonian Migratory Bird Center website (2000) reports that more than 2.3 x 10^9 kg (5 x 109 lbs) of conventional pesticides are used annually on a global scale. The U.S. is responsible for more than 0.5 x 10^9 kg (1.2 x 109 lbs), or 20%, of the total volume. Areas of use include agriculture, forest and rangeland management, insect-borne disease control, and private use in homes and on lawns, gardens, and golf courses.

TABLE 1. CAUSE OF AVIAN INJURY/MORTALITY WILDLIFE RESCUE, INC. OF NEW MEXICO

ANNUAL REPORTS 1994–98

Cause (N=2157)	% of Total	1994	1995	1996	1997	1998	Totals
NATURAL	**22%**						
Natural causes		–	80	36	143	6	263
Disease		–	1	6	21	3	31
Downed by storm		–	2	–	–	–	2
Fell from nest		10	48	26	56	12	152
Abandoned		13	–	–	1	8	21
Caught by predator		–	5	9	4	7	34
CAUGHT	**35%**						
Caught by cat		127	130	121	140	59	567
Caught by dog		32	31	32	20	15	130
Caught in building		17	9	10	7	6	49
Caught in trap		–	3	3	2	2	10
COLLISION	**26%**						
Collision w/ motor vehicle		48	43	29	33	9	162
Collision w/ train		–	3	–	1	1	5
Collision w/ window		15	29	28	44	16	132
Collision: unknown		51	40	45	52	26	223
CHEMICAL	**1%**						
Poisoned		3	6	1	4		14
Contact w/ oil		5	1	–	3		9
GENERAL	**16%**						
Human Disturbance		52	9	62	46	12	181
Nest disruption		63	–	–	–	–	63
Contact w/ fire		1	2	–	–	–	3
Gunshot		17	15	8	14	8	62
Totals: known causes (57%)		479	478	720	600	180	2157
Totals: unknown causes (43%)		256	449	243	326	323	1597

The Smithsonian estimates that about 672 million birds are exposed to pesticides on U.S. agricultural lands, and no fewer than 10%—67 million—are killed. An example outside the U.S. involved the deaths in 1995 of more than 20,000 Swainson's hawks (*Buteo swainsonii*) in Argentina due to monocrotophos, a pesticide used to kill grasshoppers (Woodbridge et al. 1995).

The organophosphate diazinon, an insecticide commonly used for lawn care, is a major cause of avian mortality. U.S. Environmental Protection Agency (EPA) data indicate "diazinon has caused the second largest number of total known incidents of bird mortality of any pesticide" (American Bird Conservancy [ABC] website 2000). Seven hundred (700) birds died in a single diazinon incident at a Long Island, New York, golf course in 1985 (ABC 2000). Although its use was restricted in 1990, at least 4.5 x 10^6 kg (10 x 106 lbs) of diazinon are still used annually in the U.S. Stone and Gradoni (1985) detailed 54 wildlife mortality incidents involving the use of diazinon. Kendall et. al. (1992) researched the application of diazinon on nine golf fairways in Bellingham, Washington; 85 American wigeon (*Anas americana*) died after grazing on a single fairway. Direct ingestion of pesticides is probably the greatest cause of mortality, according to the Smithsonian Migratory Bird Center (website 2000), but it is important to note that ingestion of residue may also occur while birds are preening, or bathing in or drinking tainted water.

Pesticides also can affect birds indirectly through reduction of available food and/or alteration of habitat. Insecticide-caused decreases in insect populations are particularly harmful to obligate insectivores; in addition, many other bird species rely on insects during the reproductive season to provide nestlings with protein for growth and development (Ehrlich et al. 1988; Martin et al. 1951). Beyond insecticides, herbicides reduce the vegetation in which many insects thrive, indirectly reducing insect populations. Herbicides also reduce plant cover used for nest concealment and avoidance of predators by galliforms, anseriforms, and other ground-nesting birds.

Mortality studies are common in the published literature. Dietrich et al. (1995) describe the death of buzzards (*Buteo buteo*) from fields treated with granular carbofuran. Elliot et al. (1996) analyzed 278 bald eagle (*Haliaeetus leucophalus*) carcasses for PCBs and organochlorine pesticides. Ohlendorf et al. (1981) examined 72 dead or moribund herons associated with organochlorine residues. Finally, Littrell (1988) investigated waterfowl and raptor losses in California rice fields treated with the carbamate carbofuran.

The American Bird Conservancy estimates that 62–92% of bird carcasses are scavenged by predators within 24 hours, and those that remain are rarely found because they are concealed in underbrush. These estimates suggest that the actual number of birds killed cannot be accurately determined. Additionally, although no data were found, scavenger predators killed through biomagnification is another source of avian mortality.

Mining and Industrial Contamination

While open pits and slag piles are commonly recognized remnants of mining, other byproducts are less well known. Heap leach gold mines collect wastewater in huge holding ponds laden with cyanide, some of which cover as much as 24 ha (60 acres). In addition to local bird populations, these large ponds attract high numbers of migratory species. A U.S. Fish and Wildlife Service (USFWS) Bulletin (website 2000) report refers to law enforcement officers investigating bird deaths at Colorado, Nevada, South Dakota, and Montana gold mines. Hundreds of birds died at a single Montana location.

Industrial activity also takes its toll. Acute fluoride poisoning from a facility in Oklahoma caused severe gastric and intestinal hemorrhage, and ultimately death, in 97 migratory snow geese (*Chen caerulescens*). Andreasen and Stroud (1987) found the on-site waste lagoons were laden with bromine, boron, and fluoride.

Crude oil spilled into ocean waters is the most likely of all chemical causes of avian mortality to receive widespread media attention, particularly if the volume of oil lost is large. The details surrounding avian mortality attributed to oil spills could fill many volumes and are beyond the scope of this review; one example is included.

As a result of the 1996 M/V Citrus oil spill, 1765 bird carcasses washed onto the beaches of St. Paul Island, Alaska, and a total of 1930 birds were impacted (Flint et al. 1999). The report did not provide details on the 165 birds described as "impacted." They were not included in the death count, and it is not known if they were rehabilitated and released. Fifty-four (54)% (867) of all birds affected were king eiders (*Somateria spectabilis*).

Oil creates serious problems on land as well, in the form of oil pits, also termed "contained oil." The USFWS began an initiative in 1987 to study the problem. Special Agent Robert C. Lee (pers. comm.) reports that the service estimated that 500,000 migratory birds (including 100,000 waterfowl) were being killed annually in "contained oil" in the oil production areas of Oklahoma, New Mexico, and Texas (Region 2, which also includes Arizona.) Lee stated this was a "very conservative estimate" derived from an intensive BLM research project in the early 1980s. The 500,000 mortalities reflect an annual toll greater than the 300,000 estimated to have died during the more recent *Exxon Valdez* oil spill. Lee reports that many of these threats have subsequently been eliminated through cooperation with the various state agencies, many oil producers, and many hundreds of criminal cases—but this success concerns Region 2 only: just last year the USFWS discovered a situation in Arkansas that is worse than anything seen thus far.

Collisions

For the purpose of this review, the collision category was separated into two subcategories: collisions with vehicles and collisions with structures. Road-kill mortality has often been investigated. Additionally, the effect of buildings and transmitter towers on birds has been tracked over many years. Until quite recently, however, these studies did not receive widespread attention.

Collisions with vehicles

People who bring birds struck by vehicles into rehabilitation centers often express surprise that the bird didn't know how to avoid being hit. WRI avian rehabilitation records include many impact injuries and deaths as a result of collision with vehicles. On an annual basis, falconiform (hawks, fal-

cons, etc.) and strigiform (owl) species appear to be most susceptible, possibly because they hunt along roads and highways. Strigiforms are generally nocturnal, which may add to their risk of collision, as they can be blinded by the headlights of on-coming vehicles. A good example involves a study done by the New Jersey Audubon Society, Cape May Bird Observatory. Loos and Kerlinger (1993) monitored a 145 km (90 mi) stretch of road in southern New Jersey over a 10-year period. Two hundred and fifty (250) road-killed raptors were found, representing six hawk and six owl species. Resident eastern screech-owls (*Otus asio*) and migrating northern saw-whet owls (*Aegolius acadicus*) were the most frequent victims. The researchers collected data from mid-October to early April, a prime window of migratory activity.

Massemin and Zorn (1998) found owls to be frequent victims of road kill along a 150 km (93 mi) stretch of highway in northeastern France. Of the 187 strigiform species collected during the 1990–94 study, 148 were barn owls (*Tyto alba*), 15 were long-eared owls (*Asio otus*), and 10 were tawny owls (*Strix aluco*). Sixty-four (64)% of the mortalities occurred along embanked stretches that crossed open fields—a sobering reminder of negative "edge effects" of habitat fragmentation (also see Mumme 1996).

Automobiles are not the only vehicles that affect avian survival. WRI records include collisions with trucks and even trains. Birds and airplanes are a dangerous combination, for both parties (USDA Environmental Assessment Report 1999). The U. S. Air Force funds a program that identifies birds by the feathers remaining inside jet engines or on other strike areas. The Bird/Wildlife Aircraft Strike Hazard Team (BASH) is located at the Air Force Safety Center, Kirtland AFB in Albuquerque, New Mexico (M. Heacker-Skeans, Smithsonian Institution 2001, pers. comm.). BASH involves two main activities: (1) Determining which birds are involved in bird strikes allows airfield personnel to better assess, predict, and ultimately prevent bird-aircraft collisions, and (2) Resulting airfield habitat management to discourage birds from frequenting the area is a key part of bird strike prevention. Skeans added that while there are many conservation activities on military installations, prevention is the primary goal of the bird strike issue.

Collisions with structures

Bird collisions with structures is another situation the public finds hard to understand; buildings and transmitter towers are so large it seems implausible they would not be seen by birds. What is generally not understood is that these structures look very different through a bird's eyes, especially when lit at night or when sunlight turns windows into mirrors.

During certain daylight hours, windows may reflect the sky in such a way that there appears to be open air space rather than a solid barrier. Klem (1990) reports that the annual mortality resulting from window collisions in the U.S. alone is estimated to be 97.6–975.6 million birds. Collisions at just one house during two 4-month periods in consecutive years from September to December resulted in 26 and 15 fatalities, respectively. "At least one out of every two birds were killed when striking the windows" (Klem 1990). Klem reports that both small and large birds seem equally at risk from mortality caused by window strikes.

Klem does not indicate whether birds that survived the collision (the other "one out of every two birds") and flew away were subsequently monitored. WRI experience indicates that many birds with window-strike injuries die shortly thereafter if corticosteroid treatment is not administered. This suggests that many birds that flew away may have died later. The confirmed mortality rate reported by Klem could thus be less than half the actual (eventual) mortality rate.

At night, lighted buildings become hazardous for birds, especially during seasonal migrations. Many migratory birds navigate by the stars (Gill 1995), and thus many species are attracted to lights, particularly those of large office buildings and building complexes. The Fatal Light Awareness Program (FLAP) of Toronto, Ontario, Canada, has conducted some of the few long-term studies of bird mortality from building strikes. Many of Canada's 250 migratory bird species are in decline, and FLAP found that approximately 10,000 birds are killed or injured annually in Toronto's downtown core alone. FLAP's Michael Mesure (FLAP website 1999) reports that more birds are killed this way each year than died in the *Exxon Valdez* oil spill. Many of these species are known to be in long-term decline, with some already designated as threatened.

It has become clear that structures other than buildings are also responsible for high avian mortality—communications towers in particular. Researchers agree the taller the tower, the greater the strike threat to birds, particularly night-migrating songbirds, although the tower's location can play a role as well.

The tower strikes presented in Table 2 reflect mortalities over periods of from 12 to almost 40 years. An unpublished report details an event in southwestern Kansas; a 128 m (420 ft) tower killed an estimated 5000–10,000 Lapland longspurs (*Calcarius lapponicus*) during the night of 22 January 1998 (M. C. Thompson 2000, pers. comm).

The Federal Aviation Administration (FAA) considers any tower 60 m (200 ft) or higher to be a potential aviation hazard. Shorter towers can present a risk to migrating birds if they are placed on hillsides. New Mexico alone has 370 communication towers, ranging from 60–245 m (200–800 ft). Since the Rio Grande River, which transects New Mexico, is one of five major migratory routes in the United States, these communication towers represent a significant threat to many migratory species. Similar conditions exist along the other four U.S. migratory routes.

Electrical power supply structures also contribute to avian mortality. McCrary et al. (1986) mention a solar energy power plant, and Osborn and Shillinger (1996) describe raptor mortality from wind turbines. However, the vast majority concern collisions with power lines.

Podolsky et al. (1998) illustrates this problem in relation to Newell's shearwaters (*Puffinus auricularis newelli*) on the island of Kauai, Hawaii. In eastern and southern Kauai, where approximately 3,000 shearwater pairs breed, the Save Our Shearwaters (SOS) program estimated that at least 70 breeding adults and 280 subadult shearwaters die each year mostly as the result of power line collisions. The adult shearwaters were killed by lines stretched across river valley flyways used to pass to and from breeding colonies. Fledglings often were grounded by what

SOS terms "fallout," whereby fledglings successfully fly to the sea upon leaving the nest, but are then attracted back to land by coastal lights. SOS rehabilitates these individuals when possible. Dark-rumped petrels (*Pterodroma phaeopygia sandwichensis*) are also killed in the same small area (Cooper and Day 1998). Because the birds fly to the ocean each morning and return inland each night, these power lines present a daily mortality risk, particularly during the summer months covered by the study. Most deaths occurred during the morning flights to the sea. (No data were found concerning mortalities outside the summer months.)

Even a limited review of the published literature indicates how widespread power line collisions have become. Specific cases are described, such as the electrocution in an urban population of Harris' hawks (*Parabuteo unicinctus*) (Dawson and Mannan 1995); electrocution of golden (*Aquila chrysaetos*) and bald eagles (*Haliaeetus leucocephalus*) in areas of high prey concentration (Woodridge and Garrett 1993); and wading bird mortality at power lines in coastal South Carolina (Savereno et al. 1996). Cranes (*Grus canadensis* and *Grus americana*), waterfowl, and other birds suffer high mortality at power lines in the San Luis Valley of Colorado (Brown and Drewein 1995).

Other countries around the world report similar mortality. Twenty-eight (28) endangered Dalmatian pelicans (*Pelecanus crispus*) were killed by power line collisions in Porto-Lago, Greece (Crivelli et al. 1988); 10 species (including herons, egrets, pelicans, gulls, and terns) were represented in the 611 deaths at a power transmission line in northeastern Venezuela (McNeil et al. 1985); and collisions with power lines appear to be a source of systematic mortality for tetraonids (grouse) in boreal forest habitats in central Norway (Bevanger 1995).

Commercial Fishing

According to Ligon (2000), fully one-third of Class Aves is adaptively tied to water (fresh or sea). The entire lifecycle of some avian species is spent at sea, with the exception of infancy and reproduction. Many of these species are impacted by commercial fishing activities.

With the exception of coastal communities, the public is generally unaware of the scope of commercial fishing, especially commercial operations based in Scandinavia and the Pacific Rim. For the purposes of this review, the commercial fishing category has been divided into three subcategories: gillnet fishing, longline fishing, and drift-net fishing. Each method poses threats to avian survival.

Gillnet fishing

Gillnets are generally 15 km-long (9 mi) nets made from varying mesh sizes of monofilament. Set near dusk and retrieved near dawn, the nets form a curtain that hangs approximately 8 m (26 ft) into the water from the ocean surface.

In 1991 DeGrange and Day published results from an assessment of Japanese gillnet salmon fishing in the north Pacific Ocean. Fishing is done both by land-based vessels that trawl the shorelines and by offshore "mothership" vessels. In 1977 it was estimated that the offshore vessels killed 151,000 seabirds annually. Suspecting that mortality from land-based fisheries would also be high, Sano (1978; in Degrange and Day 1991) estimated, from a limited sampling, that more than 160,000 seabirds may be killed annually along shorelines.

The birds, searching for prey themselves, follow commercial fishing vessels and become entangled in nets that may trail the ships by as much as 64 km (40 mi). DeGrange and Day recorded 16 species of seabirds, predominantly shearwaters (*Puffinus sp.*), followed by tufted puffins (*Fratercula cirrhata*), and thick-billed murres (*Uria lomvia*). Of particular concern are the implications for breeding populations these data reveal; all short-tailed shearwaters (*Puffinus tenuirostris*) mortalities examined in 1984 were immature, and 65% were female.

Longline fishing

This fishing method is used predominantly by the tuna industry. Longline vessels drop a main line up to 100 km (62 mi) in length, from which extend 40 m (130 ft) unweighted branches. Collectively, 2400 to 3000 barbed, steel hooks are attached to these lines. The hooks are baited with whole fish and squid approximately 300 mm (12 in) in length—sufficient size to attract albatrosses.

In a 1991 report on a decline in some albatross populations, Brothers described the deaths of 45 albatross during seven voyages of a Japanese longline vessel off Tasmania's east and south coasts. Of the 45 albatross Brothers collected, 32 were identified to species, including 14 black-browed albatross (*Diomedea melanophris*).

Japanese vessels travel south of latitude 30°S in the Southern Ocean to fish for tuna (*Thunnus* spp.), an area where albatross congregate. Of the 14 species that compose the albatross

TABLE 2. USA TOWERKILL SUMMARY

Location	Tower Height	Study Period	No. of Spp.	Total No. of Birds	Total Years	Avg. No. Birds Killed/Year
Nashville, Tenn	1368'	1960–97	112	19,800[1]	37	537
Tallahassee, Fla.	1010'	1955–80	190	42,386[2]	25	1695
Eau Claire, Wisc.	1000'	1957–94	123	121,560[1]	37	3285
Elmira, N.Y.	850'	1963–83	n/a	7,500[1]	20	375
Weston, W. Va.	529'	1978–86	58	841[3]	8	105

[1] checked only during migration [2] checked year-round [3] checked irregularly during migration
Source: Fatal Light Awareness Program (FLAP), Toronto, Ontario, Canada

family (Diomedeidae), 10 are confined to the Southern Ocean and usually come ashore only to breed on remote islands. Longline hooks and branchlines quickly sink to a depth of 60–150 m (195–490 ft), but the birds are caught on the baited hooks during the brief time the longlines are ejected from the vessel. Some birds die immediately, some trapped on the hooks die during hauling, and some are eaten by fish or torn off hooks during retrieval. Weimerskirch and Jouventin (1987; in Brothers 1991) described albatross that escaped the hooks only to die on their nests from wounds received. This suggests that actual mortality rates are considerably higher than the data indicate; indeed, Brothers offers a conservative estimate of 44,000 albatross killed annually in southern oceans.

The Wildlife Conservation Society website (2000) also lists black-footed (*Phoebastria nigripes*) and Laysan (*Phoebastria immutabilis*) albatross as victims of longline fishing. Additionally, the society reports that more than 55 seabird species are killed annually, including northern fulmars (*Fulmarus glacialis*) and kittiwakes (*Rissa* spp.).

In 1996 Cherel et al. found that diving birds were the only avian species caught by longline fisheries. The research team was investigating avian mortality from longline fishing in the vicinity of South Georgia and Kerguelen islands of the South Atlantic Ocean, both of which are important internationally as breeding areas for procellariform birds. Gales et al. (1998) discuss the impact of Japanese longline fishing within the Australian Fishing zone, the same area studied by Nigel Brothers. Estimating seabird mortalities of 1000–3500 per year, they concur that actual numbers are probably far greater because of the many which escape the hooks, only to die later, uncounted.

Drift-net fishing

This form of fishing has received a great deal of negative publicity due to the high mortality rates of nontarget species such as dolphins (*Odontoceti* spp.), other cetaceans, and various pinnipeds, including seals and walrus (*Odobenus rosmarus*). Unlike gillnets, drift-nets float only 8–15 m (25–50 ft) below the surface. Made of fine nylon mesh, they extend from 2–90 km (1.2–56 mi) beyond the vessel and are described as "walls of death" by the Earthtrust DriftNetwork Program's website (2000).

Earthtrust's website also explains that many nets are lost: referred to as "ghost" nets, they continue to "fish" as they float at sea. They eventually become so heavy from the weight of their victims, they sink or wash ashore where they entangle both birds and mammals.

The Earthtrust site states drift-netting is widely considered to be "the most destructive fishing technology ever devised by human-kind," and that millions of seabirds are killed in these nets annually. The website offered no data or references, but a literature search did provide one pertinent article.

Piatt and Gould (1994) observed the effects of commercial squid and drift-net fishing in the North Pacific Transitional Zone. From August–December 1990, 26 *Synthliboramphus* murrelet deaths were attributed to drift-nets. The American Ornithologists' Union (AOU) Checklist (1999) lists three species of *Synthliboramphus* murrelets. The Piatt and Gould article itself was unavailable, and the abstract does not clarify whether the 26 deaths involved one, two, or all three species. It does mention that "Japanese" murrelets are endangered and that "high-seas drift-net fishery mortalities represent a significant portion of the total world population of this rare and endangered species."

Although it might at first appear that the majority of avian mortalities were due to fishing vessels from Japan, a BBC News report (website 2000) states that drift nets "are used mainly by British, French, and Irish fisherman in the North Atlantic and the Bay of Biscay." The Earthtrust website says fleets embark not just from Japan, but also from South Korea and Taiwan, and operate in the Pacific, Atlantic, and Indian Oceans. Regulation of commercial fishing activities known to cause avian mortality is difficult, in part, because of the large number of countries involved.

Domestic Animals

Domestic cats (and occasionally dogs) account for a significant number of avian deaths each year. The American Bird Conservancy (ABC) developed its Cats Indoors! campaign in an attempt to educate people across the U.S. about the benefits, to both cats and birds, of keeping cats indoors. Many research papers on this subject are abstracted on the ABC website (2000); unfortunately, the author was not able to find copies of the full journal articles for this review.

A study done in England by the Mammal Society (website 1998) examined capture or kill records of 964 cats. During five months in 1997, the cat kills were in excess of 14,000 prey items. While this report did not specify how many were birds, the ABC (website 2000) mentions studies over the last 50 years indicating approximately 20–30% of cat kills are birds. By estimating the British domestic cat population at 7.5 million, the Mammal Society suggests at least 300 million birds and mammals are killed annually. This number becomes even more enormous when one considers the uncounted kills (those prey items not recovered), as well as the kills of the 800,000 feral cats estimated to live in Great Britain.

The ABC (website 2000) suggests that habitat fragmentation caused by human development provides domestic cats with easier access to wildlife forced to live on smaller and smaller parcels of land. Cats also compete with native predators by reducing species that would normally support wild predators. Rodents taken by domestic cats are unavailable to raptors, cuculiforms, and corvids. Research into the negative impact of domestic cats on native predators is fraught with difficulties, so an assessment of the problem inevitably involves speculation. Cole Hawkins, in a 1998 paper said, "Cats at artificially high den sites, sustained by supplemental feeding, reduce abundance of native rodent and bird populations" (ABC website 2000).

The introduction of domestic cats onto islands where native bird populations have evolved in the absence of mammalian predators has resulted in the elimination of entire populations of birds. New Zealand is the most notable example of such an island where avian species have not developed defense mechanisms against this kind of predation. (ABC website 2000)

WRI data indicate the majority of cat-caught birds die, even when no external injuries are visible (unpublished). Cat bites result in a warm, dark, narrow, hard-to-clean environ-

ment that is perfect for rapid multiplication of microorganisms. Cat saliva carries some very virulent bacteria, including a gram negative bacillus referred to as *CSD bacillus* or *Bartonella henselae* (Busen and Scarborough 1997). Cats' teeth generally do less damage to the tissues than dogs', but their bites are generally the more infectious. Cat- and dog-caught birds also exhibit bone fractures, soft tissue damage, and internal hemorrhage.

Summary

The anthropogenic causes of avian mortality are varied enough to exceed the scope of a single paper. Topics not addressed here include the impact of fire ants on Northern bobwhite (*Colinus virginianus*) chick mortality, and seabird mortality at Cabo San Lucas, Mexico due to toxic diatom blooms caused by contamination of waterways (Barker 1997). In addition, the range of effects of habitat destruction, illegal hunting/poaching, and even legal collecting practices by the scientific community have not been explored herein.

Birds of every order are threatened by direct and indirect human activity on a global scale. The categories and studies discussed in this review only touch on countless examples available in the literature. Action is needed in a variety of areas if the planet's avifauna is to be conserved at sustainable levels for the enjoyment of future generations and for the long-term health of ecosystems worldwide.

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Note

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To Contact the Author

Janelle Harden
(Wildlife Rescue, Inc. of New Mexico)
2710 San Rafael SE
Albuquerque, NM 87106-3031
Tel: 505/256-7607
E-mail: jharden@nmia.com

NEO-REHABILISMS...

acclimbatized
a young woodpecker who's ready to go

great horned dowl
a perch that needs cleaning

mallard
a duck that likes to shop

nuthatch
a small climbing bird; the destination of a rehabber with more than 30 nestlings

Cream of the Crop: An Improved Handrearing Diet for Hatchling and Nestling Columbids

by Astrid MacLeod and Janine Perlman

Introduction

All young animals require "baby foods"—easily digested nutrients that promote growth. Each species has evolved to provide particular baby foods using a specific feeding strategy, and while strategies may seem diverse, they have interesting commonalities.

Neonate mammals drink milk, which provides water, protein, energy, minerals, and other essential nutrients. Many birds feed insects or other prey to their young; insects and prey also provide moisture, protein, energy, and essential nutrients. Other birds regurgitate partially digested food to their young. Columbids (doves and pigeons), however, have evolved to something entirely different and much more similar to mammals.

The plant-based diets of adult columbids do not offer the nutrients required for growth, in the same way they don't offer passerines those nutrients. To provide nutrient-dense, high-protein food for their young, doves of both sexes secrete crop milk. Crop milk has a pudding-like texture and is about 70% water. The remaining portion is composed of approximately 50% protein, 45% fat, and 5% ash. Carbohydrates are present in mere trace amounts. Crop milk is actually similar in composition to the milks of some mammals, but not to those of cows, goats, etc. Such milks should *not* be fed to columbids.

The process that produces crop milk is also, in many ways, similar to lactation in mammals.

Prolactin is a hormone secreted by the pituitary gland of all vertebrates. It influences the onset of lactation in mammals and in columbids (Riddle et al. 1933), and it stimulates parental behavior in birds and mammals.

When parent columbids brood (incubate) their eggs, prolactin secretion is stimulated. At approximately the sixth day of incubation, changes begin to occur in the crop lining, and by the 13th day, the lining has thickened and is full of blood vessels. The cells of the crop lining accumulate protein and fat, and at this point they are described as "milk-laden." These milk-laden cells are shed into the crop cavity (lumen) and are then regurgitated to the young.

This phenomenon was described at least as early as 1786 (Hunter, as described in Reed et al. 1932). The great physiologist Claude Bernard actually analyzed the macronutrients of crop milk in 1859 (op. cit.), and his findings have been confirmed in numerous studies since.

While different species feed crop milk in its *pure* form for differing periods of time, it is fed to the squab, pure and then with seed or grain, for a total of 2–3 weeks. At first, the parent birds only slough milk-laden cells when the crop is empty; this ensures that the milk is not diluted by adult foods. Later, as the squab develops and matures, the milk is combined with other foods that the parent eats.

Crop milk is rich in the nutrients essential to extremely fast-growing squabs. Its constituents—high-quality (animal-based) protein for body mass and fat for caloric requirements—are present in *exactly* the amounts and kinds to which squabs have evolved. Feeding them a diet that is significantly different results in impaired growth, illness, and death. Rehabilitators have great difficulty in successfully raising very young columbids; in many cases, that is surely the result of inadequate food, consistent with the very common incidence of crop impaction, poor weight gain, and droppings of undigested food.

Plant foods do not support normal squab growth; the quality and quantity of their protein and fat are inadequate. Young squabs do no better on grain-based diets than do songbird babies raised on bread.

In addition, even if they were nutritionally adequate, seeds and grains are unavailable to the nestling squab, because it cannot break down or digest the grains and seeds of the adult diet. Its gizzard is not strong enough for the necessary grinding,

ABSTRACT: In nature, young doves are fed crop milk by their parents. This article examines crop milk synthesis and constituents and traditional hatchling/nestling handraising diets. It presents a new crop milk replacer that, unlike commonly used foods, is formulated so that it closely resembles the crop milk made by adult columbids. Also discussed are crop problems, feeding methods, and weaning to adult diet.

KEYWORDS: avian nutrition, Columbidae, Columbid nutrition, dove, pigeon, crop milk replacer, nestling pigeon diet, crop milk analysis, squab hand-rearing diet, crop impaction, tube feeding

ASTRID MACLEOD is a writer and experienced avian rehabilitator who works for Manitoba Conservation. She has researched avian nutrition for much of the past decade.

JANINE PERLMAN, an avian rehabilitator, has a PhD in biology and has conducted laboratory research in biochemistry and molecular genetics for twenty years.

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and it does not possess the digestive enzymes needed for starches. Feeding a nestling a plant-based diet is analogous to feeding a fawn nothing but alfalfa from the moment of its birth. Neither animal is equipped, when young, to survive and grow on its adult diet.

All studies agree that crop milk is about 70% water and 30% solids, and that there are almost no carbohydrates present. Earlier studies report that, of the dry matter, about 2/3 is protein and 1/3 is fat (Bernard, in Reed et al. 1932; Hegde 1973; Ferrando et al. 1971), while later ones report that crop milks of Carneaux pigeons (Kirk Baer 1999) and ring-necked doves (Harmuth et al. 1977) have nearly equal amounts of protein and fat.

Protein

Unlike passerines, doves do not hatch with significant levels of proteases—in fact, research shows that they hatch with very low levels of digestive enzymes (C. Kirk Baer, pers. comm.). Approximately 17% of the protein in crop milk is in the "predigested" form of free amino acids (Kirk Baer 1999); this may help obviate the initial need for the squab's own digestive capabilities.

Fat

Crop milk is about 35% fat on a dry milk basis, which provides calories for the metabolic demands of a fast-growing bird. The energy-dense food allows the parents to go off on extended foraging trips, and the squabs need to be fed far less frequently than do passerines.

The fatty acids that occur in crop milk are very similar to those found in mammal milk; they are mainly of long chain length. Crop milk fat is rich in essential fatty acids, as might be expected for the needs of its rapidly growing recipients.

Carbohydrate

The hatchling dove or pigeon, like passerines, does not use dietary carbohydrate for energy. Crop milk contains only traces of carbohydrate. Squabs possess virtually no carbohydrases, which is one reason why columbid rehabilitators who feed grain-based diets have experienced problems with these birds.

Rehabilitation Diets

As has too often been the case for many bird species, traditional rehabilitation diets for young columbids have been based on what the adults eat. Conventional diets for hatchling/nestling doves and pigeons include cereal grains and egg, or are premixed diets formulated for psittacines.

In these diets, levels of carbohydrate are very high, while proteins and fats do not approach levels found in crop milk. The poor-quality proteins in grains do not fill the birds' growth requirements. Obviously, hatchling doves cannot make do with a grain-based diet; if they *could* thrive on those "easy pickings" foods, it would be less energetically costly for the parents to regurgitate seed or grain to the young, without going to the metabolic expense of secreting crop milk.

Methods

Nutritional analyses presented in this paper were conducted using data from manufacturers or from the United States Department of Agriculture (USDA) Nutrient Database.

Results

Crop milk is comprised of sloughed milk-laden cells from the crop's lining. Its protein composition is much more like meat than grain. One grain-based product in common use is Kaytee Exact®. The mixing instructions of Exact® for "day 1" birds are 2–3 parts water to 1 part powder. For the purposes of this comparison, this paper analyzes the product mixed 1 part powder to 2 parts water. Its macronutrient composition and caloric content are compared with natural crop milk.

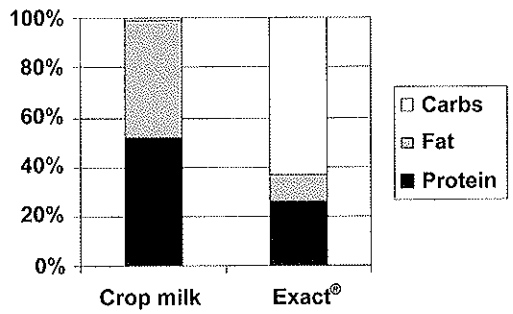
TABLE 1: MACRONUTRIENTS OF NATURAL CROP MILK AND KAYTEE EXACT®

Nutrient	Crop Milk day 1	Kaytee Exact® day 1
Water	70.0%	78.3%
Protein	14.5%	5.0%
Fat	14.0%	2.3%
Carbohydrate	0.2%	12.5%(starch)
Kcal/g	1.92 Kcal/g	0.9 Kcal/g

As shown in Table 1, Exact®, mixed 1 part powder to 2 parts water, is severely deficient when compared to crop milk. The protein and fat percentages are far too low, and given the fact that pigeon milk contains only a trace of carbohydrate, the carbohydrate levels of this product are far in excess. In fact, carbohydrates make up 57% of the calories in this recipe—and those carbohydrates are not bioavailable to the growing bird in its early days. It follows that, of the 0.9 Kcal/gram of Exact®, only 0.4 Kcal would be available. Compared with the 1.92 Kcal in a gram of pigeon crop milk, this is clearly deficient in energy content as well as macronutrients.

Even if the amount of water in the recipe were changed to reflect the 70% water that occurs in pigeon crop milk, the density of nutrients would only improve marginally.

FIGURE 1. MACRONUTRIENT LEVELS IN THE DRY MASS OF NATURAL CROP MILK COMPARED TO KAYTEE EXACT®



Crop Milk Replacer

Following the laboratory analysis of the nutrients in crop milk by Kirk Baer and Thomas (1996), the authors compared a number of possible ingredients and formulated a crop milk replacer based on the gross composition, amino acids profile, lipids, and minerals of crop milk.

MACMILK©: CROP MILK REPLACER RECIPE

1 jar (71 g) strained chicken baby food
1 hard-boiled egg yolk (16.6 g)
15.3 g (1 tbsp.) low-fat, plain, live-culture yogurt
1.13 g (1/4 tsp.) corn oil
0.62 g calcium carbonate
2 drops cod-liver oil (from gel cap)
1 drop vitamin E (diluted 1:10 in corn oil; see notes)
1 small pinch vitamin B complex (see notes)
25 mg vitamin C (ascorbic acid)

Method: Mix all ingredients in a blender. Keep the diet in the refrigerator, taking out and warming only as much as is needed for one feeding.

NOTES

Days 1–3:

For birds days 1 to 3, digestive enzymes are necessary. Use Pancrezyme® (available from vets); 0.6 cc (1/8 tsp.) per unit recipe (above). Do not use digestive enzymes from the healthfood store; they have almost no activity. Mix the enzyme in the food and let sit at room temperature for 15–30 minutes. This is crucial for neonates. Mix and use only what will be needed in one feeding; *discard the remainder.*

Vitamins: Vitamin E, as purchased, is too potent for what is required in this diet. Mix one drop of vitamin E (from a 400 IU capsule) with 10 drops of corn oil. Shake or stir well. Then, use 1 drop of the diluted vitamin E in the recipe. The remainder can be kept in an airtight container, stored in a cool, dark place, and used over the next few days. Because vitamin E degrades, it will have to be mixed fresh after a few days, so don't make too much at once. The amount of B complex required is too small to weigh on a gram scale. The amount required for this recipe is a pinch the size of about two sesame seeds. Vitamin C is an absolute requirement for some birds and a conditional requirement for others, particularly during times of growth, illness and stress (summarized in Klasing 1998). It is not harmful when added in moderate amounts, and it has been shown to be either helpful or necessary in many species. Adding it to all captive diets is recommended.

Day Four and Later:

Use crop milk replacer alone for at least the first week of life, and begin to gradually mix in other foods over a period of the next 2 weeks. During the first days of new additions, the baby bird will not yet be digesting all the carbohydrates, and the high-protein food is still needed for growth and feathering, thus a gradual changeover is necessary. Good choices might be the gradual addition of Kaytee Exact® handrearing formula, mixed baby cereal, and strained baby food corn. Be sure that any dry ingredients are mixed with water before adding to the diet.

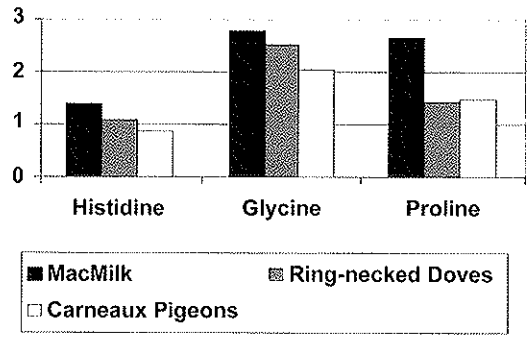
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Amino Acids

The optimal amino acids profile of a young bird's food closely matches the body composition of the growing bird. This is because the preponderance of dietary protein is deposited as new body mass in the very rapid growth that is characteristic of altricial birds.

The amino acids profile of the replacer matches very closely that of crop milk. This is to be expected, since both crop milk and the milk replacer are of animal origin. While all birds require nine essential amino acids, growing birds require three additional ones: histidine, glycine, and proline. Using these amino acids as illustrative, Figure 2 compares their levels in MacMilk® to those in the milks of Carneaux pigeons (Kirk Baer 1999) and ring-necked doves (Harmuth 1977). MacMilk® exceeds the levels of these three amino acids, as it meets or exceeds the levels of all the others.

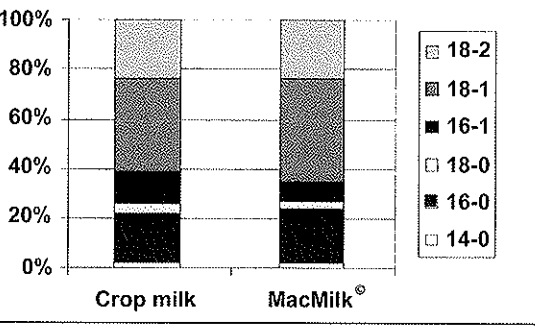
FIGURE 2. PERCENT OF DRY WEIGHT OF MACMILK® AND NATURAL CROP MILKS COMPRISED BY THREE GROWTH-ESSENTIAL AMINO ACIDS



Fatty acids

Fatty acids supply a concentrated source of calories (at about 10 Kcal/g). Some fatty acids cannot be made by animals; they are "essential," and supply components of cell membranes and intracellular messenger molecules associated with immune response. One essential fatty acid is linoleic acid, or "18:2," composed of 18 carbon atoms with 2 double bonds. Linoleic acid comprises 20% of crop milk lipids; MacMilk® is identical. The other major fatty acids are also present in very similar levels in the two foods, as shown in Figure 3.

FIGURE 3. FATTY ACID CONSTITUENTS OF CROP MILK AND MACMILK©



Minerals

The few studies measuring macro- and microminerals in crop milk are both internally inconsistent and in disagreement with each other (Shetty et al. 1990; Kirk Baer 1999). For that reason, the ranges of reported values are shown in Table 2, with a comparison to MacMilk®. The reported values are not inconsistent with a calcium:phosphorus ratio of 2:1, and since that is the ratio that is estimated to be ideal (Klasing 1998), it was chosen for the crop milk replacer.

With the abovenoted exception of calcium, the macrominerals and trace minerals in MacMilk® match very well the values found in studies of natural crop milk. This, too, is to be expected, since animal-based foods generally offer amounts of minerals comparable to one another and to the needs of youngsters. Plants are highly variable, and often deficient, in a number of minerals—another of the many reasons they should not be the basis of diets for altricial young.

The sole mineral not in the range described for crop milk is manganese, which is only about twice as high as in authentic crop milk, and is well tolerated at levels even a thousand-fold higher (Klasing 1998).

Probiotics (Summarized in Jeffrey 1999)

Birds hatch (and mammals are born) with sterile GI tracts. Their survival depends on colonization by several hundred kinds of beneficial gut bacteria (flora). To various extents depending on the animal's species, gut flora contribute crucially to the nutritional status of their host. Even more importantly, they create "competitive exclusion" of pathogens. The most effective way to establish an optimal flora population is to feed the newly hatched young some feces from a healthy conspecific adult. This is probably the case for all vertebrates.

Yogurt is added to MacMilk® for several reasons. One is that the Lactobacillus (and other) bacteria may serve as competitive excluders of pathogens, both in the birds' gut and in the food. If yogurt cultures do not colonize avian GIT's, they produce an environment conducive to the growth of beneficial autochthonous species (Eichinger 1990). All animal-based liquid foods are excellent media for pathogenic bacteria, and the yogurt cultures appear to be protective against food-borne illness as well as pathogens from elsewhere in the environment. In addition, while significant amounts of lactose are not tolerated well by birds, the small amount of lactose in MacMilk® may act as a "prebiotic," which encourages the growth of probiotics and inhibits pathogens (Corrier et al. 1997).

The GITs of a very wide variety of animals (including birds) are normally colonized by lactobacilli (Todar 2000). Lactobacillus is the predominant bacterium in pigeon crops (Baele et al. 2001).

Pancreatic Enzymes

Because of the lack of digestive enzymes in doves 1–3 days after hatch, Pancrezyme® was added to the food 30 minutes before feeding, to predigest the nutrients. This substitutes for the free amino acids found in authentic crop milk. Pancrezyme® contains a mixture of digestive enzymes (proteases, carbohydrases, lipases) and is available from a veterinary clinic. It is added to the amount needed for one feeding, and not to an entire recipe. (Do *not* use enzymes for humans from the healthfood store; they have very low activity and are inadequate.)

Immunoglobulins

Crop milk contains significant levels of immunoglobulins, particularly IgA, similar to colostrum (Kirk Baer 1999). This is likely to be important in protecting the GIT and overall health of the neonate. The authors are investigating adding colostrum containing intact IgG to MacMilk® fed to neonates and urge other rehabilitators to consider such an addition.

MacMilk on Trial

Before field trials commenced, the authors compared the major nutrients in crop milk, MacMilk®, and Kaytee Exact®. As summarized in Table 3 and Figure 4, MacMilk® compares very favorably to natural crop milk and is quite different from Exact®.

TABLE 3. MACRONUTRIENTS IN CROP MILK, MACMILK®, AND EXACT®

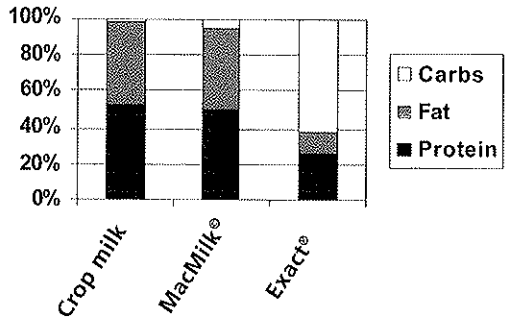
Crop Milk/MacMilk®/Exact® Comparison: As Fed

NUTRIENT	CROP MILK DAY 1	MACMILK® DAY 1	EXACT® DAY 1
Water	70.0%	73.0%	78.3%
Protein	14.5%	13.0%	5.0%
Fat	14.0%	12.0%	2.3%
Carb.	0.2%	1.4%	12.5% (starch)
Kcal/g	1.92 Kcal/g	1.7 Kcal/g	0.9 Kcal/g

TABLE 2. PERCENT (EXCEPT AS NOTED) DRY WEIGHT COMPRISED BY VARIOUS MINERALS (CROP MILK DATA FROM SHETTY ET AL. 1990; KIRK BAER 1999)

	Ca	P	K	Na	Mg	Fe ppm	Zn ppm	Mn ppm	Cu ppm
Crop milk	0.2–0.8	0.2–0.9	0.15–0.6	0.05–0.6	0.01–0.2	60–570	19–59	15–35	4–33
MacMilk®	1.22	0.61	0.54	0.18	0.05	566	54	55.5	13.5

FIGURE 4. COMPARISON OF MACRONUTRIENTS IN CROP MILK, MACMILK©, AND EXACT®



MacMilk® was tested by a number of experienced columbid rehabilitators. The first trial was performed on a group of 17 hatchling doves that included birds that hatched in captivity. When all the birds in the test group fledged, the authors felt safe in expanding the trial and many more birds were tested. Subsequent species included rock doves (pigeons), mourning doves, Inca doves, white-winged doves, and ring-necked doves.

The rehabilitators who were using MacMilk® reported good growth rates and good feathering. The droppings of birds fed MacMilk® were quite different from the watery droppings seen with Exact® or other plant-based diets. The droppings were well formed, of dark feces and white urates, as opposed to watery droppings with pale feces (indicating the nutrients were not well-digested). There were no cases of crop stasis or impaction on MacMilk®.

Feeding Hatchling and Nestling Columbids

Some columbid rehabilitators feed hatchlings 4x/day, although more frequent feedings may be advisable for very young birds. When the bird is in pinfeathers, the feedings are gradually reduced, and birds immediately preweaning are usually fed 2x/day.

Some rehabilitators prefer to tube feed, while others syringe-feed or encourage the young birds to drink.

Before feeding, of course, the bird's mouth must be opened. Many doves will open their mouths in a "gape" much like the gape of baby passerines. To encourage gaping, allow the bird to root with its bill, using the "V" between the index and middle fingers. It may take a little patience, but the bird may tilt back its head and open wide. With one hand, keep its mouth open and its neck stretched up. Then, the feeding tube or syringe can be placed and the bird can be fed. If the bird will not gape, it will be necessary to gently force open the bill. Using a fingernail to "slit" the bill, very gently open it with your fingers in a straight up and down movement. Do not exert undue pressure or side-to-side pressure. The bill is still soft and very delicate and it, or the jaw, can easily be injured.

Formula should always be wrist-temperature. The bird should be fed until its crop is full. The crop should feel like a three-quarters-full water balloon. *The bird should not be fed again until the crop is completely empty;* this will help prevent "sour crop" and crop stasis.

Tube Feeding is quick and efficient, but it is not without risks. If too much food is expressed, it will back up and the bird can aspirate it. If the tube is not crimped or removed properly, food can leak and the bird can aspirate it. If the tubing is not soft medical-grade tubing, it can injure the bird's throat.

Syringe Feeding or feeding with a large eyedropper or pipette is a good method for rock doves. Put the syringe or pipette into the right side of the mouth, past the glottis and to the back of the throat. Express the food and remove the syringe, allowing the bird to swallow and breathe before offering more. Care must be taken to not allow food into the glottis.

Drinking: To encourage the dove to self-feed, formula can be placed in a cylindrical container such as a large feeding syringe. Food is drawn up and the plunger is removed. The wide-top end of the syringe is covered with a piece of avian wing wrap that has a hole just large enough to accommodate the bird's bill. The wing wrap is secured with an elastic band. An alternative to this is to use a teat or nipple attached to a feeding syringe. Again, the teat must have a hole large enough to accommodate the bird's bill. This method allows the rehabilitator to depress the plunger so that more food is let down as necessary.

Weeks 1 and 2

The bird should be weighed daily to make sure it is gaining weight. If the growing bird is only maintaining weight or is actually losing weight, it has a problem that needs to be explored and addressed immediately.

During the first week of life, MacMilk® is fed alone. Then, other foods are gradually introduced, until the bird is weaned from MacMilk® by the end of 2–3 weeks. During the second week, you can begin to mix in Exact®, or make your own grain-based formula to add to MacMilk®. Remember that the bird is still growing rapidly during the second week, and growth continues through the third week as well. Be sure that the diet you feed is of high quality and contains the requisite protein, vitamins, and minerals in the correct amounts and proportions.

Weaning

Don't take anything for granted. When the bird begins to peck and pick up food, do not stop giving it crop milk replacer until you are sure it is digesting seeds and grains and that there are significant amounts in the crop. Young birds need to be 'topped up' while weaning because they don't obtain much nutritive value from their foods until their gizzards are strong and can grind down the adult diet, and until all the digestive enzymes have been induced. Make sure that one of the hand-feedings is given in the late evening so that the youngster has food in its crop to carry it through the night.

Be sure to provide plenty of clean, pesticide-free dirt and oystershell grit ad libitum, along with seeds. Dirt provides many beneficial minerals and microorganisms; oystershell grit provides crucial calcium and assists in seed grinding.

Discussion

Columbids comprise a cosmopolitan order that populates many of the most challenging environments. It is postulated that much of their success stems from the crop milk provided by parents to nestlings (Horseman and Buntin 1995). Like mammals, young columbids are provided a "perfect food,"

regardless of their larger environment. Pigeons and doves occupy ecological niches that do not allow them to gather food that would permit the remarkably rapid growth of their young. One might hypothesize that, since columbids have not evolved to capture invertebrates, which would meet the macronutrient demands of growing nestlings, they secrete their own animal-based food, instead.

Passerines have solved the need for high-nutrient food differently. Unlike columbids, songbirds must raise their young in a time and place where insects abound. Many of them migrate in order to do so, an enormously expensive and risky endeavor. The songbird "baby diet" of insects is about 65% water, with dry matter comprising 62% protein, 20% fat, and 18% carbohydrate (in the form of glycogen and chitin). Passerines hatch with good levels of proteases, the enzymes required to digest dietary protein. In their first week, they largely depend on protein for both building blocks and energy. Lipases begin to function later, and they are relatively incapable of digesting carbohydrate until their second week.

Compared to the insect diet of baby passerines, crop milk is similar in the level of high-quality dry matter protein, much higher in fat, and much lower in carbohydrate.

The differences between columbid milk and insects fed to passerines (higher fat and virtually no carbohydrates in crop milk) reflect the physiological differences of the birds and the differences in feeding frequency. Whereas songbird babies need small, frequent meals of moderate caloric density, dove and pigeon nestlings have relatively large crops that allow large, high-calorie meals, fed less often.

Young pigeons and doves can digest only protein and fat—not carbohydrates. The enzymes to digest starches do not appear until well into the second week of life, and even then the birds only gradually acquire the ability to digest carbohydrates. As is true of all wildlife, to give them anything other than what they evolved to digest, and therefore are *able* to utilize, does them a grave disservice and puts their health and life at risk.

Like all young animals, nestling doves and pigeons are what they eat—so make sure they eat the cream of the crop.

Acknowledgements

We thank Charlotte Kirk Baer for her great generosity in sharing her published and unpublished data and her thoughts; Diane Winn for ever-helpful discussions and information; and R. nair Jayakumar for his generous assistance.

Product Information

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

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To Contact the Authors

Astrid MacLeod
Box 17, Group 75 RR 1
Anola, Manitoba R0E 0AO
Canada
E-mail: sparrow1@mb.sympatico.ca

Janine Perlman
14817 Willy Lane
Alexander, AR 72002
USA
E-mail: jpandjf@swbell.net

NEO-REHABILISM...

fincubator
a recycled fish tank used for housing baby birds

Get Stuffed for Easter

by Nancy Eilertsen

ABSTRACT: East Valley Wildlife, a small volunteer organization in a desert community, has developed a humane, environmentally safe, and profitable alternative to the live Easter duckling/chick/bunny.

KEY WORDS: Easter duckling/chick/bunny, fundraising, volunteers, domestic waterfowl, parks, humane Easter baskets

NANCY EILERTSEN is founder and director of East Valley Wildlife and has been involved with wildlife rehabilitation since 1988. She specializes in songbirds, waterfowl, and herons. She is coauthor of *A Flying Chance*, a manual for rehabilitating North American passerines, and has also written a manual on the rescue and rehabilitation of domestic waterfowl.

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Introduction

East Valley Wildlife (EVW) is a network organization of home-based volunteers involved with the rescue and rehabilitation of native wildlife such as songbirds, small mammals, migratory waterfowl, and water birds in the Phoenix, Arizona, area. EVW's volunteers also deal with a problem common in this desert community: they rescue, raise, rehabilitate, and foster the orphaned, injured, and abandoned domestic ducks and geese that are so prevalent on the numerous community lakes (in press). In order to attempt mitigation of the continual repopulation of these lakes with newly abandoned domestic waterfowl, and in the continual pursuit of funding, the organization developed the "Get Stuffed for Easter" program.

Discussion

Each spring EVW, through the Get Stuffed program, makes a concerted effort to discourage the age-old custom of giving live ducklings, chicks, and bunnies to children at Easter for the sole purpose of watching their eyes light up when they first see the cuddly little creatures.

Since they are so cute and cuddly (and extremely fragile), many of these animals die from over-handling or when children hug them to death or the family pet uses them as a chew toy. Most people do not realize the animals' vulnerability; they are not aware of their specific food and housing requirements. Those animals that do survive become unmanageable and problematic; very quickly, they are no longer "cute."

All too often the solution to this unwanted pet problem, when it concerns ducklings, is "set them free." The locale of choice is usually one of the artificial lakes in the Phoenix area. Animals that have been completely dependent upon humans are released without any of the skills necessary for survival. Unfamiliar with natural foods, unable to forage, and unfamiliar with predators, they literally become sitting ducks. Most of these ducklings are domestic breeds and are unable to fly. They wander into yards and approach people in search of food. Many starve to death; those that are rescued are often so weak that they are unable to stand. Others fall victim to dogs; yet others are injured or killed, victims of abusive people.

For the past five years, EVW has complemented its Get Stuffed program with the partner "Don't Park Your Duck" campaign (in press). The campaign seeks to educate people about the fate of domestic waterfowl that are left to fend for themselves, with the message that live animals are living, feeling creatures, not disposable playthings.

Solution

Each year EVW invites the public to help with the Get Stuffed program. Volunteers are organized into groups according to their interests and skills: crafters, shoppers (those who enjoy garage and bargain sales), and organizers.

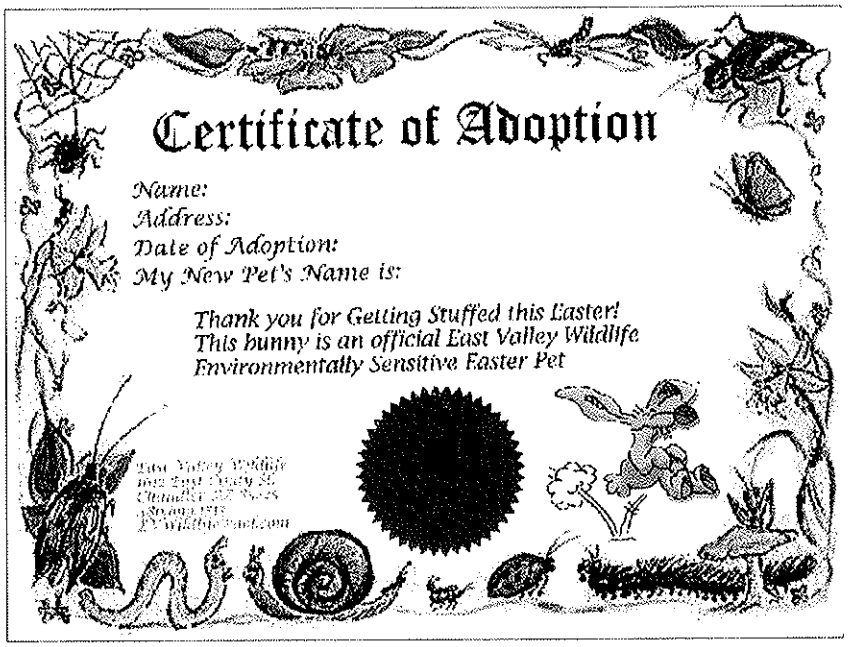
The Get Stuffed for Easter program is marketed each spring; however, preparations for next year's campaign begin just after each Easter. Volunteers visit dollar stores, toy stores, fabric stores, and the like, buying clearance items at post-Easter sales when stuffed ducklings, chicks, and bunnies; baskets; and trim materials can be purchased at very low cost. Prices of baskets, toys, raffia, and Easter grass are reduced by 75 percent, and stuffed animals cost as little as $1 to $2. Volunteers also "rescue" stuffed animals that were given as gifts to small children in the previous holiday season. People donate these toys (in new condition), as well as baskets and other Easter trinkets they no longer want.

In early winter, volunteers who enjoy crafting begin creating the baskets. Each volunteer is given an assortment of supplies (ribbons, raffia, fuzzy chicks, silk flowers, and other Easter craft trinkets). Volunteers work at home; the finished products are then brought to distribution points (volunteer homes in various locations around the Phoenix area). Here, the baskets are filled with Easter grass and a stuffed animal.

Some of these homes act as locations where the public can select and pick up the baskets they order.

Each Get Stuffed Easter basket includes a stuffed toy, complete with an EVW name tag, official adoption papers, and information about wildlife care—all this, and a hand-decorated Easter basket, too! The volunteers even take special orders, creating theme baskets and personalized gifts.

Theme baskets have become increasingly popular. The Noah's Ark basket comes with six small stuffed exotic animals, such as lions, elephants, and bears. This theme came about when a number of tigers and other animals not native to North America were donated. A GI Joe basket features camouflage ribbon and little plastic soldiers. There are a number of special order baskets for little girls, including one that is pink and fluffy, decorated with bows and silk flowers.



Each Get Stuffed animal comes with an official adoption certificate.

Baskets that contain items that could be swallowed come with a warning notice, advising that the basket is not suitable for children younger than three. Baskets for very young children are adorned safely and simply, with ribbons and bows.

The baskets (and program) are advertised in local newspapers, the East Valley Wildlife newsletter, and flyers distributed to wild-bird stores and veterinary clinics. Well before Easter, local media cooperate to promote the campaign. Articles in the larger daily and weekly newspapers have produced the greatest return, especially when they are accompanied by a picture of a volunteer surrounded by orphaned ducklings. Baskets are also sold at a local church that sponsors the organization. One Sunday morning several weeks before Easter, volunteers set up a table and sell the baskets to parishioners at two services. For each of the past four years, they have collected a minimum of $300 between 8:30 A.M. and noon.

Baskets (and stuffed animals) come in varying sizes to accommodate every budget. In newspapers and flyers, three sizes are advertised: large ($25), medium ($20), and small ($15). At the church sale and at fairs and other events, prices start at $5 and range to $25, so that children or those who are looking for token gifts can find something to fit their pocketbooks.

Volunteers will also make up and mail a gift to a special person (e.g., grandkids, favorite aunt, grandparents). Because baskets proved to be too difficult to wrap securely, the "special person" package contains a stuffed animal along with an adoption certificate, name tag, wildlife booklet, and card with a personalized greeting, for the cost of $15.

The ratio of cost to benefit is approximately 1:5, with $5 being the greatest investment in a basket that sells for $25. Labor, of course, is donated. Get Stuffed has become so popular that repeat orders are received well in advance of promotions.

Among the most enthusiastic supporters of the campaign are the park rangers in the Phoenix area. The rangers have been networking with EVW for years in an effort to deal with the issue of abandoned domestic animals. This opportunity for public education has proven to be an enjoyable event for all parties.

With five years of experience, the Get Stuffed working group operates like a well-oiled machine. The group knows what sells in the community and has developed good relationships with area businesses and media. And because EVW is a network of home-based rehabilitators without a central facility, this annual project allows volunteers who want to be part of the group but who cannot take in or rescue animals the opportunity to contribute their skills, talents, and time.

Conclusion

EVW offers people a perfect, environmentally safe, and humane alternative to the live Easter duckling, chick, or bunny. Get Stuffed pets are totally huggable. There are no worries about accidents on the floor, specialized diets, or housing, and they're quiet and very well behaved. Thanks to the imagination, creativity, and determination of East Valley Wildlife and its volunteers, "getting stuffed" for Easter is all that it is quacked up to be.

To Contact the Author

Nancy Eilertsen
East Valley Wildlife
1612 E. Cindy Street
Chandler, AZ 85225
USA
E-mail: EVWildlife@aol.com
Website: www.evwildlife.org

Note: A companion article on EVW's Don't Park Your Duck campaign will be published in the summer 2002 issue of the *Journal of Wildlife Rehabilitation*. Please see page 39 for a Ditto that you can use now to encourage the public *not* to "park their ducks."

SIMPLE SOLUTION

Building Squirrel Boxes

by Pat Issacs



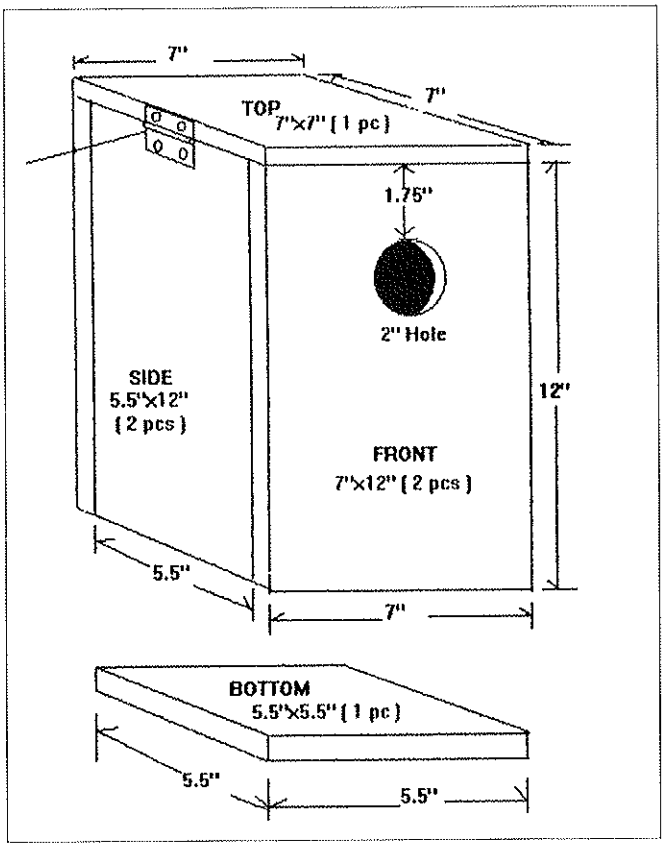
PHOTOS: PAT ISSACS

If you enjoy a small, practical project that can bring the satisfaction of a job well done, building a squirrel box—an intermediate home for a squirrel that is being rehabilitated—might be for you.

The hinged lid allows the rehabilitator easy access for inspection and feeding. The box also allows the rehabber to move the animal from a smaller weaning cage to a larger prerelease cage without changing its "home." As the animal's climbing skills develop, the box can be moved up the wire cage walls. When laid on its side, the box allows chipmunks, babies whose eyes are just opening, and injured adults a secure area in which to hide.

The plans and instructions given here are intended as guidelines. You do not have to follow the directions implicitly, as squirrels are not particular when it comes to the quality of their dwelling. As they grow, they will gnaw out the entrance hole to meet their needs, resulting in a somewhat less than beautiful box. Do not paint or apply any finish to the box, this may be toxic to the animal. This wooden box should not be hung in a tree or placed outside in a nonprotected area.

The dimensions of the box are based on the size requirements of the Southern grey squirrel in its prerelease stage. If one wanted to house Southern flying squirrels, the only modification necessary would be decreasing the size of the entrance hole to a 2.54 cm (1 in) diameter. For larger species of squirrels such as the fox squirrel, increase the diameter of the entrance hole to 8.89 cm (3.5 in), and increase the overall dimensions of the box.



MATERIALS NEEDED:

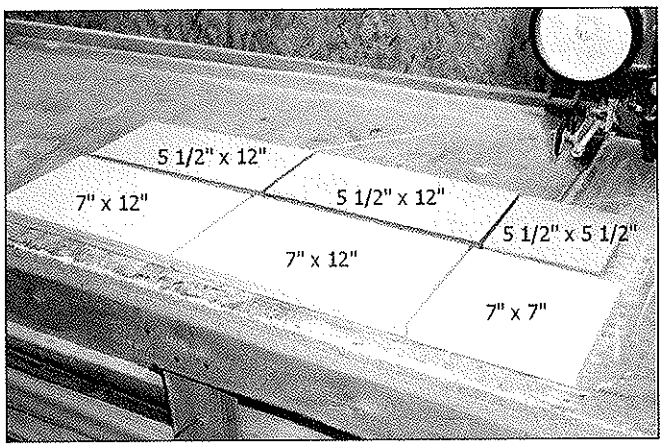
- Small piece of scrap 0.32 cm (0.125 in) plywood
- Small box of 4d finishing nails
- Small hinge with screws
- Two 8d or 10d nails (to be used as hooks)

TOOLS NEEDED:

- Bench saw (recommended) or circular saw
  (If you don't have a power saw, check with friends and neighbors for one you might borrow)
- Hammer and screw driver
- Electric Drill with 1/16 in bit
- 5 cm (2 in) hole saw
- Tape measure or ruler and pencil

Note: Since smooth Birch plywood was used on the box pictured being built in these pages, it was necessary to score the front of the box slightly for paw holds. Normally, lesser grade plywood would be used, such as "B/C." This type of wood is rough enough for a squirrel to get a paw hold.

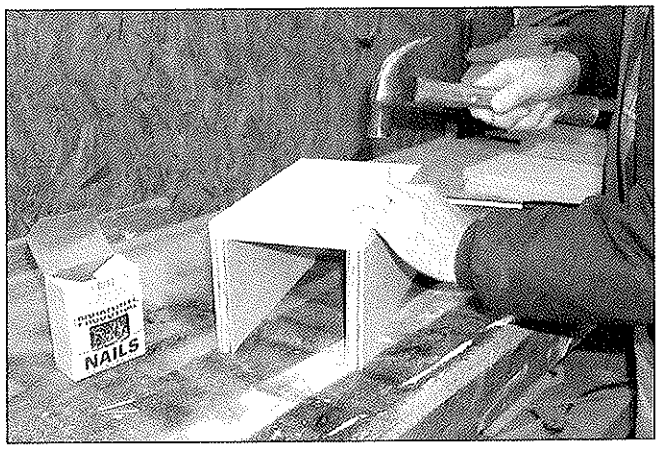
DIRECTIONS:



< STEP 1

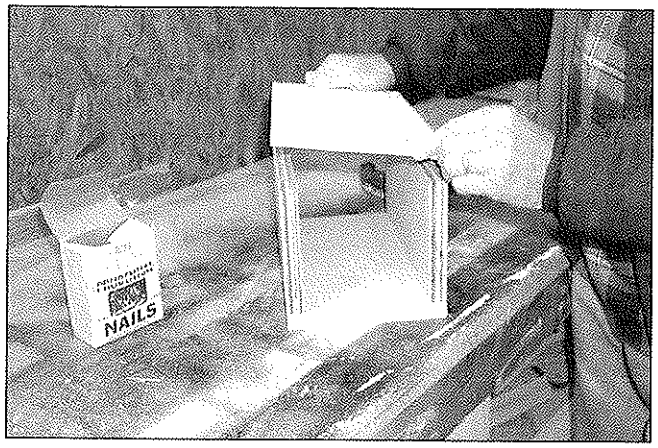
Mark the plywood and cut into pieces as shown. Cut the plywood into 2 pieces (one 17.78 cm [7 in] wide and the other 13.97 cm [5.5 in] wide). Then cross cut those pieces into sections as shown. You should end up as follows:

2 pieces 30.5 x 14 cm (12 x 5.5 in) (sides)
1 piece 14 x 14 cm (5.5 x 5.5 in) (bottom)
2 pieces 30.5 x 17.8 cm (12 x 7 in) (front & back)
1 piece 17.8 x 17.8 cm (7 x 7 in) (top or "lid")



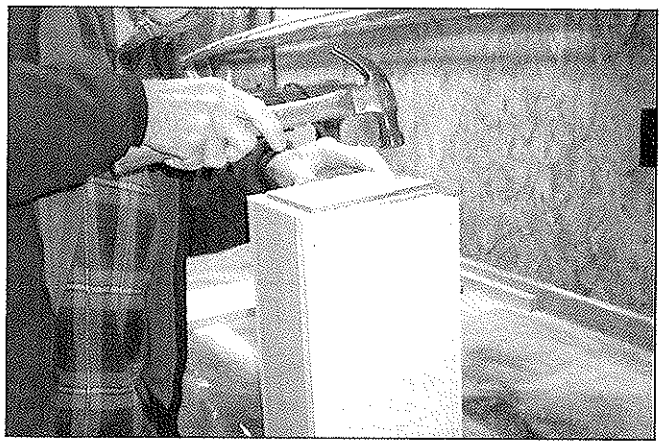
STEP 2 >

Begin by nailing the front to the sides. (If you have trouble nailing, you can make it easier by pre-drilling small pilot holes for each nail).



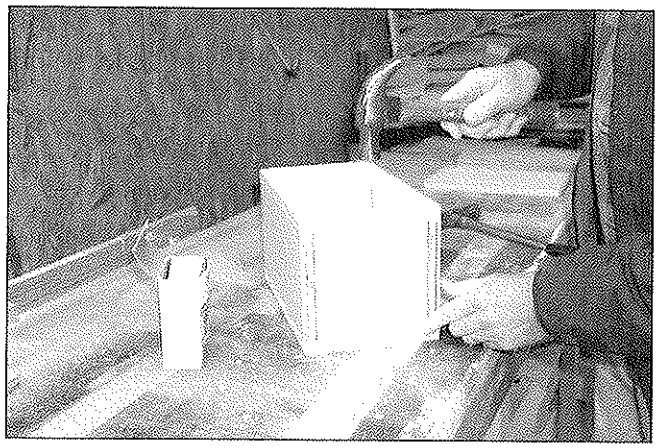
< STEP 3

Nail the back to the other pieces. Nailing on a solid surface will make the job easier.



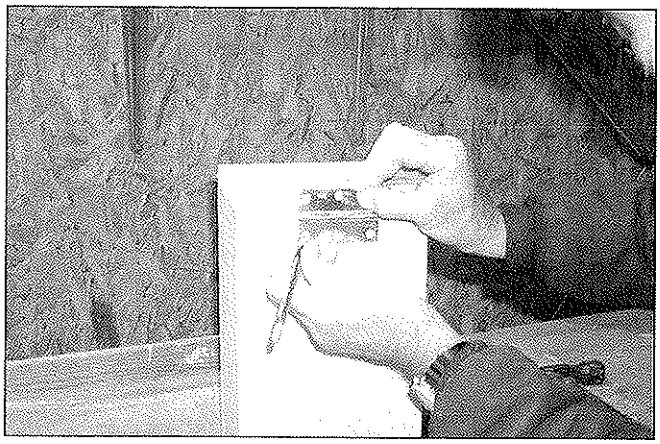
STEP 4 >

Tap the bottom (14 x 14 cm [5.5 x 5.5 in] piece) into the hole on one end of the box.



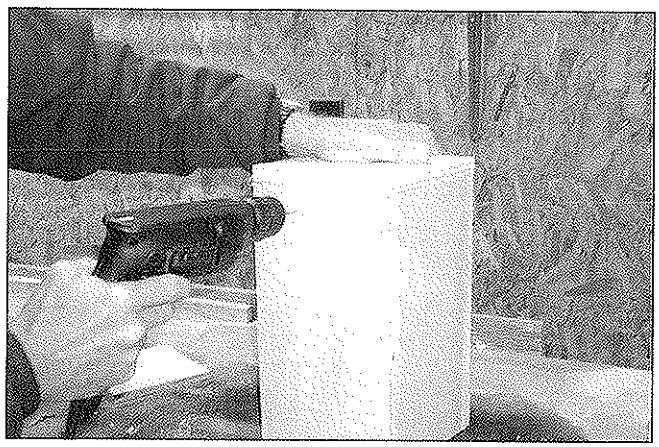
< STEP 5

Nail the bottom to the box sides.



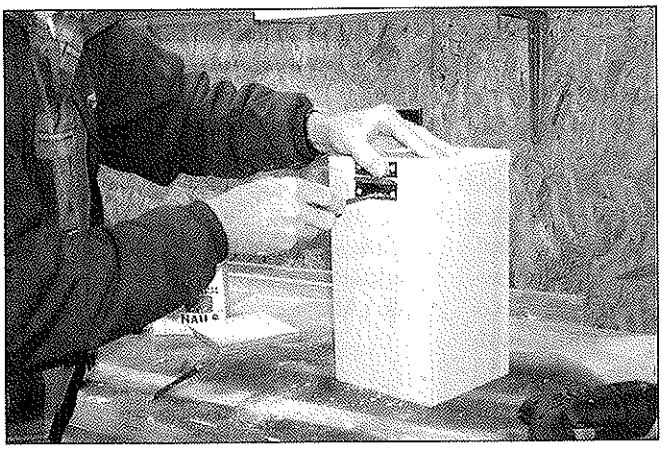
STEP 6 >

Mount the top piece (lid) to the box with a small hinge. Hold the hinge in position and mark the location of the mounting holes. The hinge may be mounted on the back or either side of the box. Most people prefer the back.

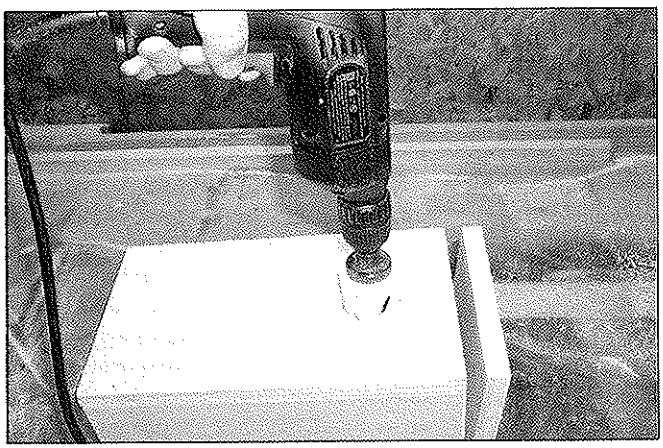


< STEP 7

Drill small screw starting holes for mounting the hinge.

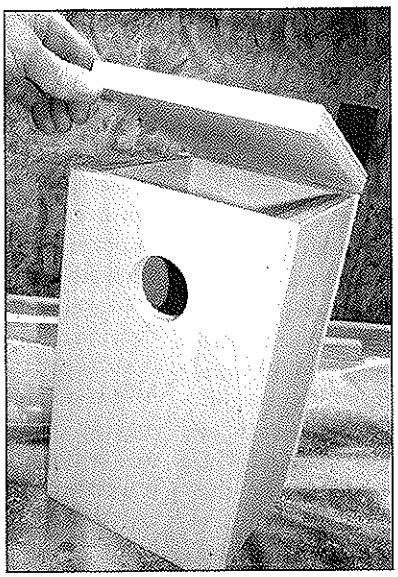


Almost finished! >



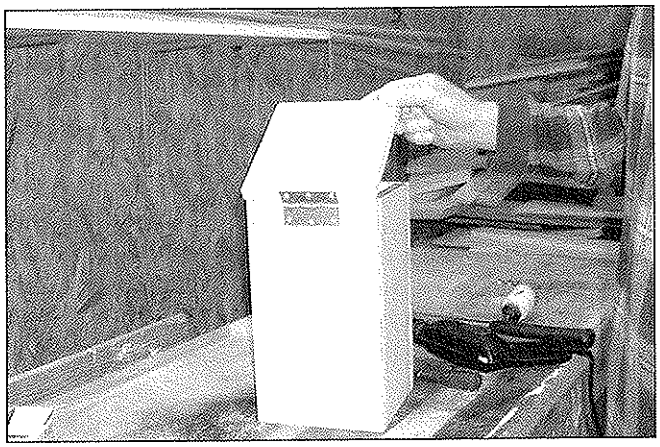
STEP 10 >

Side hooks may be added to facilitate hanging the box in a wire cage. Simply drive 2 small nails into the sides as shown and bend them over at a 90 degree angle.



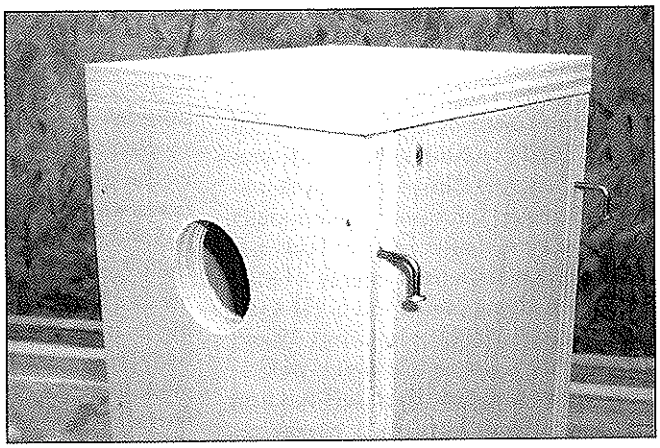
< STEP 8

Mount the hinge with the screws. Phillips screws are easier to use.



< STEP 9

Mark the center of the hole and drill it out using the 5 cm (2 in) hole-saw. The hole should be centered and approximately 6.35 cm (2.5 in) down from the top.



< The finished box should look approximately like this. UWR

AVIAN SPECIES

Patterns of Food Preferences in Mourning Doves

S. E.Hayslette and R. E. Mirarchi
J. Wildlife Mgmt. 65(4): 816–27.

The authors determined that in both captive and wild diet studies in Alabama, mourning doves preferred the following foods. In cultivated seed: white proso millet, wheat, browntop millet, and corn. In wild plants: broadleaf signalgrass, switchgrass, and yellow bristlegrass. There were a number of speculations about why these foods were preferred, but researchers determined that both wild and captive mourning doves forage selectively and that, when available, white proso millet is the most preferred seed.

Prefledging Energy Requirements in Shorebirds: Energetic Implications of Self-Feeding Precocial Development

H. Schekkerman and G. Henk Visserb
The Auk (118)4: 944–57

The authors studied prefledging energy budgets in chicks of black-tailed godwit (*Limosa limosa*) and northern lapwing (*Vanellus vanellus*) in the field and in the laboratory. Lapwings show slower growth than godwits. Daily energy expenditure (DEE), measured by the doubly labeled water (DLW) technique, and daily metabolized energy (DEE plus energy deposited into tissue) increased proportionally to body mass at similar levels in both species. Total metabolized energy (TME) over the fledging period was 8,331 kJ in godwits and 6,982 kJ in lapwings, 39 and 29% higher than an allometric prediction. This suggests that self-feeding precocial chicks have high energy requirements compared with parent-fed species, due to costs of activity and thermoregulation associated with foraging. Those components made up 50–53% of TME in the shorebirds, more than twice that of seven parent-fed species for which DLW-based energy budgets are available. In captive lapwings and godwits growing up under favorable thermal conditions with food readily accessible, thermoregulation and activity costs were 53–58% lower and TME was 26–31% lower than in free-living chicks. The proportion of TME allocated to tissue formation was low in the shorebirds, and reductions in food intake may therefore sooner lead to stagnation of growth than in parent-fed chicks. While self-feeding may allow birds to use food types that could not be profitably harvested if they had to be transported to the young, self-feeding precocial chicks seem to operate within fairly narrow energetic margins.

MAMMALIAN SPECIES

Influences of winter supplemental feeding on the energy balance of white-tailed deer fawns in New Hampshire, U.S.A.

M. D. Tarr and P. J. Pekins
Can. J. Zoo./Rev. Can. Zoo. 80(1): 6-15

The purpose of this study was to determine the influence of supplemental feeding on the energy balance of white-tailed deer (*Odocoileus virginianus*) in northern New Hampshire, USA, during January–March 1997. The authors measured the field metabolic rate (FMR) and energy balance of 10 (5 males and 5 females) supplementally fed wild fawns with doubly labeled water over 19–21 days. The authors tested whether percent acid detergent fiber (ADF) and percent neutral detergent fiber in deer fecal samples predicted the proportion of supplemental feed (pelleted concentrate) in the diet of deer. The mean FMR of fawns was 758.4 kJ·kg–0.75·d–1 (range = 535.9–1032.8 kJ·kg–0.75·d–1), or 2 ◊ their basal metabolic rate (BMR). The mean FMR of male fawns was >30% higher than that of female fawns. Percent body fat (12.1 ± 1.4% (mean ± SE)) and mass loss (3.0 ± 0.9%) varied among fawns, suggesting that an individual high FMR was not detrimental to energy balance and was related to availability of feed. We estimated that a high FMR (>2 ◊ BMR) could be maintained only if fawns consumed about 1 kg of supplemental feed daily. Radiotelemetry data indicated that the number and juxtaposition of feeding sites in an area probably influenced home range and activity of deer. Percent ADF in feces provided the best prediction of percent grain in the diet (% grain = –0.048(% ADF)2 + 1.523(% ADF) + 96.467; r2 = 0.69) and was useful for identifying populations consuming supplemental pelleted concentrate. Biologists should expect that the influence of winter feeding on energy balance and survival will vary according to the interrelationships of deer density, food availability, and winter severity at feeding sites. *(Abstract ©NRC Research Press)*

CONSERVATION

Terrestrial Wildlife Responses to Logging and Fire in a Bolivian Tropical Humid Forest

N. J. Fredericksen and T. S. Fredericksen
Biodiversity & Conservation 11 (1): 27–38

Logging and wildfire are significant anthropogenic disturbance agents in tropical forests. The authors compared the abundance and species richness of selected terrestrial wildlife taxa including small mammals, amphibians, reptiles, and terrestrial invertebrates in areas burned by wildfire and then logged, and in adjacent undisturbed areas of a tropical humid forest in Bolivia. Disturbed areas had 24% less canopy cover than undisturbed areas but 2.6 times the cover of large woody debris. Understory cover did not differ between disturbed and undisturbed areas. Small mammal abundance and species richness in disturbed areas were 43 and 70% higher, respectively, than in adjacent undisturbed areas. Herpetofaunal abundance did not differ significantly among disturbed and undisturbed areas, but trends for higher abundance were observed for both reptiles and amphibians in disturbed areas. Herpetofaunal species richness was significantly higher in disturbed compared to undisturbed areas. Total terrestrial invertebrate abundance, as estimated by pitfall traps, was significantly higher in undisturbed compared to disturbed areas mostly due to higher abundances of Formicidae and Blattidae. However, two invertebrate groups, Orthoptera and Lepidoptera (larvae) were more abundant in disturbed areas. Wildlife conservation strategies for areas where logging or wildfire occur should take into account species- or guild-specific responses to these disturbance agents. *(Abstract © 2002 Kluwer Academic Publishers.)* JWR

CALL FOR PAPERS

International Wildlife Rehabilitation Council
25th Annual Conference

Hosted by the Lindsay Wildlife Museum

6–9 November 2002
Concord Hilton
Concord, California, USA

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Presentation categories may include but are not limited to:

- Natural History (diet & nutrition, behavior, identification, etc.)
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- Administration (fundraising, volunteer management, staff issues, etc.)
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If you would like to participate in this important meeting, please submit your proposal by the deadline of 30 June 2002. All submissions are subject to committee review and presenters will be notified in writing regarding the acceptance of their proposal(s).

Return your completed application(s) to:

IWRC 25th Annual Conference
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USA
Fax: 707/864-3106
E-mail: iwrc@inreach.com

DEADLINE: Proposal(s) should reach the IWRC office no later than 30 June 2002 in order to be considered for the program.

CATEGORIES OF PRESENTATIONS

PAPER: An oral presentation on new and proven techniques, original research, case studies, species paper, and so on. May make use of video or audio tools (slides, film, computer or electronic presentation, or overheads). A **written manuscript** which will be published in the conference proceedings, is a **requirement** of this category.

WORKSHOP/TUTORIAL: "Hands-on" sessions which demonstrate techniques or skills in a particular area of study. Should conclude with a finished product, completed project, or a learned skill. For example, grant writing, physical therapy, splinting, etc. Presenter may limit enrollment in order to keep the class size workable. Some workshops may also include a materials fee when necessary. **Handouts, outlines, or plans** for individual workshops are encouraged to be submitted for inclusion in the conference proceedings.

DISCUSSION GROUP/ROUNDTABLE: A moderated discussion group amongst peers on a specified topic or area of concern. A **summary** of topics discussed or conclusions arrived at during the session is encouraged to be submitted for inclusion in the conference proceedings.

PANEL: A moderated, focused presentation on a specific topic, presented by a panel of experts with open discussion and participation from the floor. A **summary** of topics discussed or conclusions arrived at during the session is encouraged to be submitted for inclusion in the conference proceedings.

ALSO CONSIDERED

POSTER SESSION: A visual display presentation on paper highlighting a particular project, plan or case study. May include photographs, diagrams, blueprints, or drawings.

PRESENTER ABSTRACT GUIDELINES

Abstracts should contain a concise and factual summary of the information to be presented. The abstract should include the following components: statement of purpose, study design, findings, and conclusions. Supporting information should be provided whenever possible. The title should appear in capital letters above the abstract and the body of the abstract should be printed or typed.

Name, academic degrees, and current professional affilitations of the primary presenter should be listed on the proposal application in the space provided. The same information should be provided for copresenters or coauthors.

Presenters may submit more than one abstract. An individual application should be submitted for each presentation.

Material presented during the meeting must be based on the same information contained in the submitted abstract or manuscript.

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Presenter: _____ Title: _____

Affiliation: _____

Address: _____ City: _____

State/Province: _____ Country: _____ Postal Code: _____

Home Phone: _____ Work Phone: _____

Fax Phone: _____ E mail: _____

Best time/location to contact: _____ Copresenter: _____

CATEGORIES OF PRESENTATION/TIME REQUEST

NOTE: If you wish to include Q & A time after your presentation, please allow for this in your time request. Workshop presenters please allow for set-up and break-down time where necessary. The IWRC reserves the right to limit presentation time where necessary, with proper notification.

Please indicate category and circle time requested (note that we have allowed 5 minutes between presentations in order to facilitate sessions).

Poster Session	Display only		
Paper/Case Study	25 min	40 min	55 min
Discussion Group/Roundtable	40 min	85 min	
Workshop/Tutorial/Panel	55 min	115 min	Other: _____
(For workshops): Class size limt?	Y N		Limit number: _____

Presentation Title: _____

Conference abstract: Minimum of one paragraph. Please attach extra page if additional room is needed. I hereby acknowledge and agree to IWRC procedures and deadlines as outlined in this call for papers.

_____

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Sign and mail return to: IWRC, 4437 Central Place, Suite B-4, Suisun City, CA 94585-1633, USA
Or fax return to: 707/864-3106. E-mail: iwrc@inreach.com **DEADLINE: 30 June 2002**

Salmonella Traced to Owl Pellets

In early April, the *New York Times* reported that when *salmonella* broke out at a Minnesota elementary school, health department officials first investigated the lunch program. However, most of the children infected belonged to either the science or the adventure club. Interviews revealed that the science club had been dissecting owl pellets—on a cafeteria table at which the adventure club later ate. The table was not washed until the following day, by which time more children had eaten at it.

The pellets came from a barred owl at a local nature center. Cultures of leftover pellets and the owl's droppings turned up the same strain of *salmonella* found in the children; the bacteria almost certainly came from the owl's diet of thawed, uncooked chicks.

In the *Times* article, epidemiologist Fred Anderson said there was no reason to ban owl pellets from school programs, but suggested that the pellets not be dissected in the lunchroom, and that students wash their hands when finished. Better still, owl pellets can be sterilized in an oven, or sterilized pellets can be bought from commercial suppliers.

Senate Rejects Drilling in Refuge

Despite intense pressure from the White House and last-minute maneuvering by drilling proponents, on 18 April the U.S. Senate voted against opening Alaska's Arctic National Wildlife Refuge to oil and gas exploration. In two procedural votes, Democrats and several Republicans defeated a pro-drilling amendment to a broader energy bill, delivering a victory to wildlife conservationists and environmentalists.

A rugged wilderness, the refuge teems with caribou, polar bears, Arctic wolves, and millions of migratory birds each summer. The Bush administration has championed its drilling as a cornerstone of its national energy plan, even though the refuge would likely yield less than a six-month supply of oil. Senate drilling advocates have pledged to raise the issue again. The House of the Representatives has already passed an energy bill that would allow drilling—a key difference that will have to be hammered out when, and if, the Senate passes its version. JWR

Military-Nonprofit Initiative Saves Woodpecker Habitat

The Pentagon and its Congresional supporters are trying to win the right to violate environmental laws on military reservations, saying that these laws hinder their ability to train soldiers. However, as National Public Radio reported in early May, at Fort Bragg (North Carolina), the U.S. Army's largest reservation, officials have found that endangered species laws can be beneficial.

Fort Bragg's 161,000 acres of mostly longleaf pine forests and fields are fast being surrounded by sprawl. The fort's new neighbors complain about the smoke and noise from ammunition and helicopters. And as the development continues, wildlife—including the endangered red-cockaded woodpecker—is taking refuge inside the fort.

In a unique partnership, the Army and the nonprofit Nature Conservancy have each provided $7 million to fund the Private Lands Initiative. The Conservancy is using the money and the Endangered Species Act to buy what's left of the undeveloped land around Fort Bragg. The longleaf pine forests are then preserved as woodpecker habitat; they also serve as a buffer between the fort and development. The Army may train soldiers there, minus the live fire. JWR

Wildlife–1; Wrestlers–0

Following a legal loss to the World Wildlife Fund over the initials "WWF," the World Wrestling Federation will change its name to WWE, or World Wrestling Entertainment. Changing its products—which include clothing, toys, video games, magazines, and TV shows —will take months and could cost the new WWE up to U.S. $50 million.

The legal battle between the two organizations dates back to 1989, when the federation applied to trademark its name. The World Wildlife Fund, based in Switzerland, opposed the trademark. The fund trademarked the WWF logo in 1961, shortly after its founding, and feared that association with wrestlers would hurt its image. The two groups came to an agreement over use of the logo, but by the early 1990s, the fund alleged that the wrestlers had violated the deal.

A second agreement was reached in 1994, but in 1997 the federation started its wwf.com website and began promoting promoting WWF products. The fund sued in a British court, and last year a judge ruled in its favor. When the wrestlers appealed, Britain's Court of Appeal dismissed the case. The new WWE plans one more appeal of the British trademark ruling, this time to the House of Lords. JWR

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COLUMN

Operating Instructions

SONGBIRDS NESTING IN THE WRONG PLACES

by Nathalie Karvonen

Many small birds, like other types of wildlife, try to find homes in urban areas and often choose ones that people don't necessarily like. When your center finds itself deluged with calls about giving the birds an eviction notice, be prepared with the right advice.

Starlings

Starlings are notorious for their love of vents. Dryer, stove, or bathroom exhaust fan vents—they like them all. They have become quite adept at lifting the little plastic flaps that cover many vents and letting themselves in. Once they have chosen this spot to rear their young, they stuff nesting material in—up to five feet of it! Usually the home's human inhabitants don't realize the birds are even there until the babies hatch and start calling for their food, or until mites from the nesting material start to crawl into the home.

If the caller is just hearing the babies but has not been invaded by mites, they will often agree to leave the babies alone until they fledge. It is important to explain that it only takes about twenty days for the young to leave the nest. Probably by the time the caller contacts you, the baby birds are just days away from fledging. Next, explain what fledgling birds are and what the caller can expect to see from the little family. Once the birds have safely left the nest, the caller should remove all the nesting material (remember to tell them to wear a face mask and wash their hands well afterwards), clean the vent with a mild detergent, and then cover the vent with a solid piece of hardware cloth or a commercial cover that is bird-proof.

If the caller is being visited by mites, or is unwilling to allow the babies to fledge on their own, you may need to tell them to remove the nest. If they do this, they should prepare a very clean 4-litre plastic jug (e.g., the kind that windshield wiper fluid comes in), leave the cap on, and poke some small holes in the bottom for drainage. They should then cut a square hole in the side about 6 inches from the bottom of the container. Tell them to cut only the three sides along the right, left, and bottom of the square; the top edge should be left intact and the flap flipped up, like a little awning that will protect the opening of the jug from the elements. The nest and babies should be carefully moved into the jug, and the jug should then be hung from the vent cover. The parents should continue to feed the babies in the new home. The caller can put a proper vent cover on, but instruct them to do it quickly and quietly and replace the jug as soon as they are done the work.

Note: We never recommend that a caller remove a nest with eggs. The parents are unlikely to care for them in the new location; they seem to need to bond with the babies before the nest can be successfully moved. Also, it is very important to explain that the jug must be hung from the vent cover: it should not be moved any significant distance away or the parents may not recognize the babies as their own.

Robins

Male robins are very determined when defending their nesting area. Callers will report a bird repeatedly attacking a window or windows of their house. Once a description of the bird is obtained, usually it is indeed an American robin. Sometimes these territorial males will even knock themselves out on windows—incensed by the reflection that they think is another male robin. Callers should be advised that this behavior will last just two or three weeks at most. In the meantime, the windows of the house should be soaped to cut the reflective properties or newspaper taped over the outside. Again, assure the caller that these are only temporary measures.

House Finches

Pretty little house finches are known for their habit of nesting in hanging plants, and virtually every call our hotline receives about birds nesting in a hanging plant is about these birds. Often the caller is concerned about their plant and wondering if they can water it. It is important to provide the caller with some natural history to assure them that the finches won't need the plant for long. Generally, the eggs are incubated for about two weeks and the babies fledge about two weeks later. If the caller is very careful about watering the plant (i.e., uses a tiny spout, slowly and carefully pouring water in at the edge of the pot so as not to get the nest wet) and only does it when they absolutely have to (i.e., once the leaves start to droop), they should be able to keep their plant healthy and allow the finches to raise their family as well.

General Advice

Each year, we all get many calls about birds that nest in inappropriate places. Always determine first what species the caller is describing and research the natural history of the bird. Generally, the time for birds to incubate their eggs and rear their young to the point of fledging is short, and most callers can "stick it out" until the babies have left the nest. It is then important that they take steps to ensure that birds do not return.

If the caller cannot wait until the babies have fledged, be creative and help them find a humane resolution. We once received a call about red-winged blackbirds that had nested in an ornamental tree that was in a heavy planter in a large garden center. The parents decided that the customers were a threat to their nest and had started dive-bombing people as they walked by. We instructed two brave staff members to tie a rope around the planter. We asked them to move it one foot at a time, waiting each time for the parents to find the nest again and feed the babies. By the end of the day, the tree had been slowly moved right out of the garden centre and around the corner into parking lot! JWR

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

COLUMN

Food for Thought

FAT-SOLUBLE MICRONUTRIENTS

by Astrid MacLeod and Janine Perlman

The fat-soluble essential micronutrients include vitamins A, D, E, and K; essential fatty acids; and choline. Additional nutrients that may be conditionally essential include coenzyme Q_{10}, alpha-lipoic acid, carotenoids, and other substances that are still being characterized. Vitamins A and E, coenzyme Q_{10}, alpha-lipoic acid, and carotenoids were described as antioxidants in the most recent "Food for Thought" column.

Vitamin A

Vitamin A serves other crucial functions, as well, in its three physiologically active forms. One form, retinal, is present in the retina and serves as a photoreceptor (is activated by light). Another form, retinoic acid, is required for normal growth and maintenance, notably of epithelial tissue. For companion birds deficient in vitamin A (because of a poor-quality, all-seed diet), respiratory infections are a common cause of death. Such infections are often secondary to the development of abnormal epithelial tissue in their respiratory tracts. This abnormal tissue serves as growth sites for the lethal pathogens.

Vitamin A is also needed for reproduction, bone growth, and immune system function.

As noted in the previous column, some carotenoids, particularly beta-carotene, can be converted to vitamin A by many animals. Carotenoids generally occur in orange, yellow, or red fruits and vegetables. Beta-carotene is particularly plentiful in pumpkins, red bell peppers, and, of course, carrots. Vitamin A is found mainly in liver, and to a lesser extent in other fatty tissues. Remember that carnivores of any class probably cannot use the carotenoids from plants to manufacture vitamin A; they must obtain the vitamin from foods of animal origin.

In captivity, carnivores that are not fed whole prey, and granivores are especially subject to deficiencies. Excesses of vitamin A are toxic, causing liver damage and general symptoms of malaise. Beta-carotene is not, however, toxic at high levels.

Vitamin A is fairly labile (unstable) during storage.

Vitamin D

Vitamin D is a steroid hormone. It regulates growth of a number of organs and tissues, including bone, intestine, and kidney. In some cases it acts directly on genes, one of which encodes an intestinal transporter protein for calcium. Vitamin D stimulates the synthesis of that protein and thus permits the absorption of dietary calcium. Vitamin D thereby prevents rickets, or metabolic bone disease, whose symptoms of crippling and soft, deformed, and/or broken bones are known to most rehabilitators. It is the only vitamin that is also a hormone and is unique in other regards, as well. It is made in amounts sufficient to meet metabolic needs when the skin of animals is exposed to UV light with wavelengths around 300 nm. This wavelength of light is present in sunlight, but it is filtered out by glass or plastic.

Synthesis of vitamin D in the skin is well regulated regardless of amount of sun exposure. On the other hand, it is possible to overdose an animal by dietary supplementation; in fact, this is the vitamin most easily given in toxic excess. It is both toxic at low multiples of the recommended intake, and relatively stable in storage. When excessive vitamin D is ingested, calcium is absorbed in excess, while it is also mobilized from bone. The resulting excessive blood calcium can result in malaise and joint and kidney damage, along with calcium deposits in other areas (e.g., respiratory tract and cardiovascular system) where they don't belong. Accurate knowledge of an animal's requirement, and of the amount of vitamin D fortification in foods, must be applied when supplementing a captive diet.

Unlike most animals, many mammals can use dietary vitamin D_2, which is a vitamer found in some plants. However, fish, amphibians, reptiles, and birds can only utilize dietary vitamin D_3. When they are exposed to sunlight, some invertebrates and plants make substances that appear to be antirachitic (preventive against rickets) when those organisms are consumed. However, such organisms do not require vitamin D themselves, and hence are not reliable dietary sources. In fact, because body stores of the vitamin are low, there are no reliable sources of vitamin D_3 in naturally consumed foods of captive animals, except for oily marine fish.

Vitamin E

The antioxidant function of vitamin E, whose vitamers are *tocopherols*, was described in the last "Food for Thought" column. Vitamin E is well tolerated in levels more than ten-fold the required amount, and indeed appears to be more healthful at such levels than near the minimal requirement. There is some evidence that natural mixed tocopherols may be more biologically useful than pure alpha-tocopherol. The requirement for vitamin E is correlated with the level of polyunsaturated fatty acids in the diet.

Vitamins E and A compete for absorption, so more of one increases the requirement for the other. Plant oils are the richest natural sources of vitamin E. In air, the vitamin is oxidized and destroyed quickly.

Vitamin K

Vitamin K is needed to activate proteins that are constituents of blood clots. It is also required for skeletal health, and for kidney tissue. It may be necessary in a broad array of other tissues and organs as well.

Natural vitamin K is found in two basic forms—one synthesized by plants (the phylloquinones) and one by bacteria (the menaquinones). It is not made by animals. The turnover rate of the vitamin is very high, and body stores are very low. This reflects the facts that it is needed in small concentrations and is made continuously by gut flora. It is also present in significant amounts in green leafy plants.

Yet a third form of the vitamin, the menadiones, is present in artificial supplements. The natural vitamins K are nontoxic in amounts much greater than the requirement, but menadiones may be toxic at high levels. Vitamin K is rarely needed as a supplement in captivity for healthy animals with access to feces (which often provides a very rich source). However, if animals have no access to feces (e.g., granivorous birds kept on grate cage bottoms), and/or if they have been on antibiotics, they can become vitamin K deficient. Vitamin K requirements can rise substantially if foods are moldy, because some fungi produce coumadins, which are vitamin K antagonists.

Sources of live probiotics, such as yogurt, have vitamin K activity, thanks to production of the vitamin by the bacteria.

Choline

Choline is part of a main constituent of cell membranes, and it is required for acetylcholine, a major neurotransmitter. Along with methionine (an essential amino acid) and the vitamins folate and B_{12}, choline is also required for normal processing of DNA in ways that prevent cancer.

Choline has been shown to be necessary for normal brain development in rats, and for some time it has been considered an essential nutrient for domestic and companion mammals and birds. It is required at about 1% of the dry weight of the animal's diet.

It is present in significant amounts in animal fat (liver and egg yolk are particularly rich sources), and seemingly for that reason it has received little attention in Western studies of human nutrition. Recently, however, it was deemed an essential human nutrient as well.

Essential Fatty Acids

Essential fatty acids, or EFAs, are long-chain, highly unsaturated fatty acids (for a description, see Food for Thought, *J. Wildlife Rehab.* 24[2]: 30–32) that are made by plants but cannot be synthesized by animals. One role of EFAs is structural, as components of cell membranes. Thus, deficiencies cause generalized and nonspecific symptoms. They are also important in the protective oily barrier between the skin and the environment. In carnivorous and omnivorous mammals, dry, flaky skin, pruritus, bacterial skin and other infections, alopecia, and reproductive failure are common symptoms of deficiency.

Essential fatty acids are sometimes divided into omega-3 and omega-6 types, depending on the location of their double bonds. The two fatty acids that are required by all animals are alpha-linolenic acid (18 carbons and 3 double bonds, or sites of unsaturation), which is an omega-3 type; and linoleic acid (18 carbon atoms and 2 double bonds), an omega-6 type. Fatty Acids (FAs) with more than one double bond are known as polyunsaturated fatty acids, or PUFAs.

Herbivores and omnivores can use these two EFAs to make arachidonic acid (20 carbons and 4 double bonds) from linoleic acid, and eicosapentaenoic acid (20 carbons and 5 double bonds) from alpha-linolenic acid. These two 20-carbon fatty acids are, however, essential in the diets of carnivores, which obtain them from their prey and have lost the ability to make them.

Arachidonic and eicosapentaenoic acids are the precursors to biochemicals that function as "signals," such as prostaglandins, leukotrienes, and thromboxanes. There are several *prostaglandins* (and *prostacyclin*) made in response to infection, and they often mediate reactions to pathogens such as inflammation, vasodilation, platelet anti-aggregation, and fever. Aspirin and some other antipyretic, anti-inflammatory medications work by inhibiting an enzyme required for prostaglandin synthesis. *Leukotrienes* also promote inflammation, particularly that resulting from allergic reactions, and often act by constricting smooth muscle. *Thromboxanes* act in a variety of ways, sometimes (but not always) opposite to prostaglandins.

Arachidonic acid, as an omega-6 FA, produces signal molecules in the omega-6 family; they are involved in inflammatory and clotting responses. Linoleic acid, from which arachidonic acid is derived, originally comes from plants (certain seed and nut oils in particular) and is bioaccumulated in animal tissues.

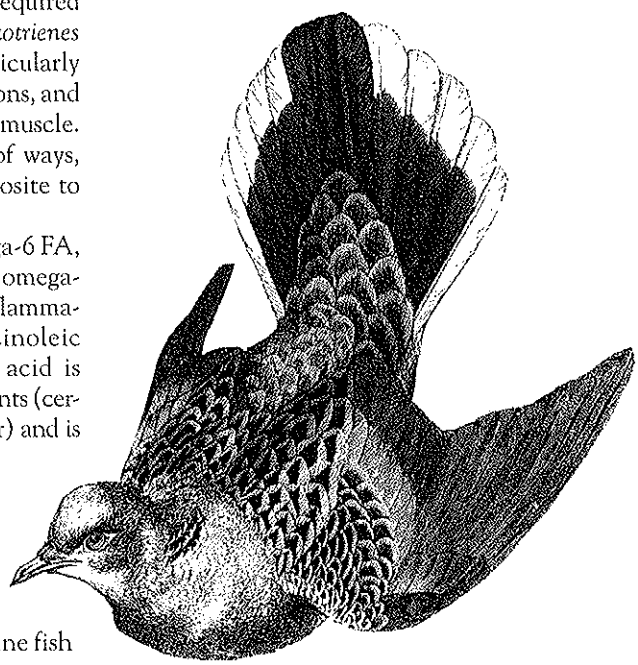
The omega-3 fatty acid eicosapentaenoic acid is made into omega-3 type anti- inflammatory and anti-clotting molecules. Plant leaves, some seed and nut oils, and cold water marine fish oils are high in omega-3 fatty acids; fish oil is used as a supplement for reducing itchy skin and inflammatory reactions in dogs, for example. Dodeca-hexaenoic acid is an FA also in this family; it contains 22 carbons. It also appears to be essential for some animals at some life stages; for example, there is increasing evidence that it is required for normal brain development in the diet of human infants.

The more PUFAs that are ingested, the higher the requirement for vitamin E, which helps prevent the oxidation of the double bonds in these crucial molecules.

A "Mystery" Cure

In addition to the known properties of these substances, fat-soluble nutrients can occasionally have wondrous and salubrious effects on animals in rehabilitation. One of the authors was caring for a dove with an old injury that had resulted, some months previous, in the proximal portion of the maxilla being desheathed of its keratin covering. For unknown reasons, that portion of the bill began to grow and swell abnormally, but without any sign of infection. In other words, it appeared to be displaying idiopathic hyperplasia. It seemed that the nares might soon become occluded. The dove was on a vitamin-enriched diet and there was no reason to suspect any dietary deficiencies.

However, the author was aware that vitamin A has been shown to reverse



cancerous characteristics of cells *in vitro*. Reasoning that hyperplasia, like cancer, is a form of unregulated growth, cod liver oil was applied in a thin film to the affected area once daily. Within 24 hours, the area had begun to shrink, and within 5 days, the area had regressed to complete normality. The problem has arisen and been resolved in this way a total of three times at this writing.

Consultations with avian veterinarians produced no guesses as to the mechanism of this apparent "cure." We speculate that the vitamin A and/or the omega-3 fatty acids in the cod liver oil are the curative agents. The vitamin A may act as it does on other cells—directly on gene expression, to normalize control of growth. The omega-3 fatty acids may result in the cellular production of anti-inflammatory, anti-swelling compounds. We may never know.

The components of cod liver oil, along with other fat-soluble nutrients, retain a delicious air of mystery. JWR

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

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

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

NEO-REHABILISMS...

bipologists
two scientists with opposing opinions

biowlogy
the ability of strigiformes to fully rotate their heads in both directions

COLUMN

By the Book

POISONED COYOTES, APPROPRIATE EUTHANASIA, AND MORE

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

Q Some protected birds in our area have been shot by native people who intend to use the feathers for ceremonial purposes. Can we help prevent the killing of healthy wild animals by giving them feathers from deceased birds? Or is there another procedure we should follow?

A The laws, regulations, and policies that regulate the killing of migratory birds by Native Americans for religious purposes are complex and beyond my ability to explain in this forum. At one time the National Eagle and Wildlife Repository accepted carcasses, feathers, and parts of any species of migratory bird that could be used by Native Americans for religious purposes. Recent legal challenges by non–Native Americans have resulted in the repository accepting and distributing carcasses, feathers, and parts of golden eagles and bald eagles only. Currently, there is no mechanism to give feathers of other species of migratory birds to Native Americans. In many cases it is illegal for Native Americans to use migratory birds for any purpose. If you suspect any illegal activity or if you are not sure, contact your closest Special Agent.

Q We recently received some poisoned birds of prey and a poisoned fox from an area where a farmer is putting out bait for coyotes. Is this legal? How can we persuade the farmer to stop this behavior? What kind of evidence is necessary to associate the poisonings with the farmer?

A It is not legal to distribute poisoned baits to kill coyotes. This is a serious violation and a high priority for investigation by the USFWS. It is not your duty to persuade someone doing this to stop. You should immediately contact the closest Special Agent, who can advise you how to safely preserve poisoned carcasses. These carcasses contain valuable and deadly evidence that require forensic analyses. The Special Agent's job is to conduct the investigation and attempt to link the crime scene, the victim, and the suspect. Your job is to assist in every way you can.

Q I've just learned that a local rehabilitation center is feeding live (injured or orphaned) protected species to carnivores. Is this legal?

A Generally, a rehabilitator must release, transfer, retain, or euthanize a migratory bird brought to them. Euthanasia is defined as the intentional causing of a painless and easy (i.e., humane) death. This topic is often emotional and controversial. The methods used are various and differ widely in their effectiveness. Some of the quickest and most painless, like cervical dislocation or decapitation, are often not used because they are viewed as barbaric and require a hands-on technique. However, these methods are certainly quicker and cause less trauma than other preferred methods. I encourage permittees to utilize migratory bird carcasses as food for other recuperating animals providing the carcasses do not contain communicable disease, toxic shot, euthanasia drugs, or anything else that could be harmful. Feeding live migratory birds is quite different and would require careful consideration. A quick death from an able raptor seems more humane to me than being placed in a carbon dioxide chamber and also provides a valuable training experience for the bird of prey. This procedure, while not necessarily prohibited by law, could be quite controversial and should be used only if you can assure that the death will be swift. Placing a migratory bird in a pen to be chased and mauled by a carnivore would not be appropriate and would be in violation of Standard Condition 8 in all regions of the USFWS, except Region 5, which does not implement this Standard Condition. JWR

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

COLUMN

Open Minds

GETTING SMART ABOUT DEALING WITH DESPAIR

by Beth Dillingham

The face of childhood despair about the environment revealed itself to me on a brisk winter day with a class of twenty-five fifth graders in the Sandia Mountains outside of Albuquerque, New Mexico. We had been on a short hike and were in the classroom building getting ready for a longer hike through the pinon juniper, ponderosa, and fir forest communities along the trail. We were talking about all the things that wild creatures need to survive and what we must do to take care of the earth that sustains us all. I asked how we might begin to solve the problems facing our planet, and a young boy said, with a great sorrow in his voice, "The problems are too bad; there's nothing we can do."

The other children all seemed to agree. My heart sank. It stunned me to realize how much hopelessness these ten year olds felt about the environment. I scrambled to think of hopeful stories, to tell them about all the efforts that are being made to make things better. It seemed to help the kids to hear about restoration work. But the room really came back to life when they were given a chance to imagine their own solutions. I gave them some chalk and let them draw. We listened to ideas, and everyone was encouraged to think out loud. One boy drew a very complicated machine to help with global warming. Others drew devices to deal with pollution. These were childhood musings, but I hope these young people still carry around today that sense of possibility. That day forever changed my thinking about talking with kids—and adults—about environmental concerns. As environmental educators it is important that we understand the workings of despair and get smart about the emotions we deal with.

We all carry our own despair, or sense of hopelessness, about the state of the environment. There is no denying that the indicators are frightening: species extinction, water scarcity, and climate change are daily reminders that we have to make big changes to turn the situation around—and soon. Media images of tragedies from around the world can serve to overwhelm us. In an attempt to get people to react, many individuals and organizations are often deliberately heavy handed with tragic information. When one cares deeply about an environmental or wildlife concern, it is natural to want to pull out the stops and hammer people with information—information that will surely make them jump out of their seats and take action to solve the problem. Instead, what seems to happen is that we tap into people's environmental despair, and they shut down. The result is no help to our concern and an even more disconnected audience.

So how can we reach out to people in a way that can bring about the interest and energy necessary to make the changes in our lives to solve these problems? More particularly, how can we reach out to children to encourage their creativity and interest in being a part of a more environmentally sustainable future?

The first step is to understand how the loss of hope affects us. We need to recognize and acknowledge our fear and despair about the environment if we are to prevent ourselves from feeling only numb and hopeless inside. One consequence of despair is to make us passive participants in our lives. If however inadvertently we teach despair to our children, they, too, will learn to be passive . We need to teach them about the problems while helping them see the possibilities as well.

And there is real hope out there. There are countless conservation success stories. Without trying to be a Pollyanna, I always mention stories of hope. I often tell kids about the bald eagle, our national bird, that was in real trouble due to the use of the pesticide DDT. I explain that scientists figured out what was causing the problem and used their skills to help resolve it. The use of DDT was banned in this country and the bald eagle population, along with other raptors, is recovering. There are species that have recovered enough to be taken off the Endangered Species List. There are captive-breeding efforts in accredited zoos across the country to help build up the populations of the world's endangered species. There are countless habitat restoration projects going on all over the world. Every day many people are trying to live in a more careful way to help keep wildlife and wild places healthy. There are all kinds of efforts going on to address pollution problems, and we are constantly learning more about how to understand and work on these large concerns.

We all need to hear hopeful stories and to find actions that we can take to make things better. Those of us who use live educational animals have the perfect opportunity to display a living example of a story of hope—hope not only for the individual animal who may have been rescued from the consequences of an accident, but hope that this kind of attention from many people can eventually make things better.

Children also need the opportunity to do hopeful work. Whether it is a school-based recycling project, a campus trash cleanup or a fundraising drive to help in wildlife rehabilitation work, or picking up a naked baby bird found on the ground, they need to get involved in problem-solving efforts. It is always important to let them know there is a lot that they can do. And don't forget that wildlife rehabilitation is an excellent model of hopeful activity. You are terrific role models who clearly demonstrate how individuals can make a difference.

As educators, let's invest our energies in becoming more informed of the progressive steps being taken on behalf of the environment. Let's get smart on the effects of despair—and let's study and speak up about the progress being made by the many champions of wildlife and the environment.

JWR

Beth Dillingham has taught in both classroom and informal learning settings for fourteen years. She ran an environmental education center in the Sandia Mountains in New Mexico, and is currently the education coordinator for the Rio Grande Zoo. She may be reached at thebnm@earthlink.net.

FACT SHEET

Rehabilitation Notebook:

CANINE DISTEMPER IN GREY FOXES (*UROCYON CINEREOARGENTEUS*)

Causative Agent

Canine distemper is caused by a virus in the paramyxovirus family. The disease was first recognized 200 years ago and was first reported in free-living wild animals in 1955.

Clinical Signs and Lesions

- Clear to purulent discharge from the eyes and nose
- Dry or moist cough
- Fever
- Lethargy and depression
- Vomiting and diarrhea
- Thickening of foot pads
- Seizures, "chewing gum" movements of mouth, tremors
- Incoordination, clumsiness
- Loss of fear of humans

Common Hosts

- Domestic dogs
- Raccoons
- Coyotes
- Ferrets and other mustelids
- Most mammalian carnivores are capable of carrying the disease. It is rare in red foxes. Distemper has been suspected in a few noncarnivores, including javelinas (related to swine) and hedgehogs.

Transmission

Transmission can occur through direct contact or by contact with infected oral, respiratory, and ocular secretions. Because the course of the disease in grey foxes is very rapidly fatal and the virus does not survive for long outside of the host, epidemics occur only in dense grey fox populations. However, sporadic individual cases do occur.

Diagnostics

- There are several tests that are used to detect antibodies against the virus in serum.
- Diagnosis can also be achieved by looking for typical microscopic changes in various tissues, such as brain, lung, kidney, liver, pancreas, gallbladder, urinary bladder, or stomach.
- The virus can be isolated and identified in lung tissue.
- In live animals, a swab of the eye's mucous membranes can be examined using a fluorescent antibody test.

Treatment

Treatment is not successful in grey foxes because of the severity of the disease in this species. Because some of the clinical signs of distemper can also be caused by the rabies virus, if exposure to humans or domestic animals is suspected, the animal should be immediately euthanized and the brain examined for evidence of rabies by an appropriate diagnostic laboratory.

Prevention

As this is an infectious disease, suspected cases should be strictly isolated and good hygiene exercised. Grey foxes should not be vaccinated against canine distemper using commercial domestic animal products. There have been a number of cases of the modified live virus in the vaccine reverting to the virulent state and actually inducing the disease in the vaccinated animal. The new recombinant canarypox canine distemper vaccine by Merial should be safe in any species; however, it is not licensed for use in grey foxes.

Public Health Concerns

This disease does not affect people; however, because of the similarities in clinical presentation between canine distemper and rabies, foxes with these signs should not be approached. The same virus that causes distemper in grey foxes also causes the disease in unvaccinated dogs. It is not known whether distemper can be spread from fox to dog through contact with infected animals or their secretions, but it may be possible.

This Fact Sheet is based on one prepared by the Wildlife Center of Virginia and is published with the center's approval.

Conservation Classics: *The Land of Little Rain*

by Mary Austin
Reviewed by Elsa C. Bumstead

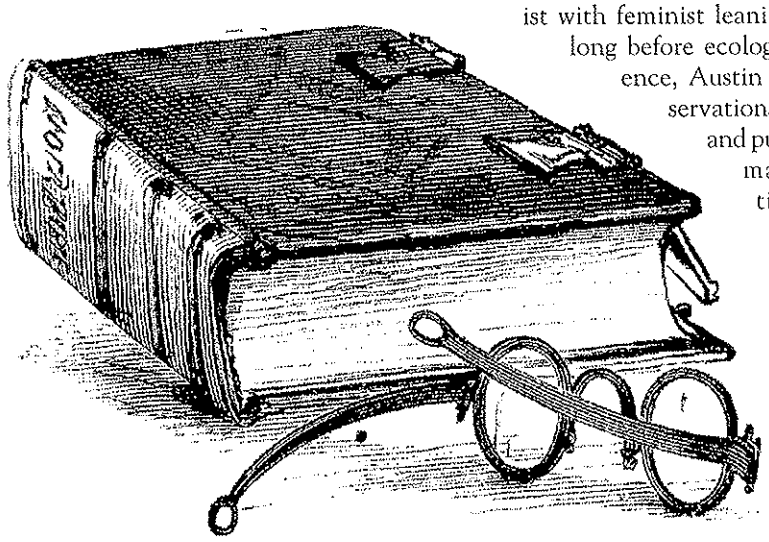
Albuquerque: University of New Mexico Press, 1974
(reprint of the first edition, 1903)
171 pp.; U.S. $11.95 (paperback)
ISBN: 0826303587
per barnesandnoble.com

Mary Austin was an essayist, novelist, poet, and playwright who lived from 1868 to 1934. According to the preface of *The Land of Little Rain*, her childhood was spent in a farming community in southern Illinois. Her father's library became the source of her developing literary interests and her intent to become a writer. When her father died in 1878, he left a pension and a farm to his widow and three children. Mary was educated in Carlinville, and then entered Blackburn College. There she selected science as a major because, for science, she needed laboratories and teachers; she felt she could study English by herself. She graduated in 1888.

When she learned of homesteading opportunities in southern California, her mother and brothers decided to rent their house, and the family moved west. It was there that Mary met, and in 1891 married, Stafford Wallace Austin, an owner of a vineyard south of Bakersfield. As a farmer's wife Mary Austin began writing for San Francisco's *Overland Monthly*. Her first story was published in 1899 and from then until her death, she wrote and published nine novels, three plays, fifty short stories, a number of articles and poems, and twelve books of nonfiction.

It was the heartland of southern California that captured Mary Austin's soul. When her husband was offered a position in Owens Valley on an irrigation project, she became absorbed in the timeless and colorful world of coyotes, ravens, buzzards, and roadrunners, along with prospectors and their burros, Native American basket makers and medicine men, mesa trails and stagecoach towns. From her base in Independence, Austin sought out the solace of land and sky. As a gifted storyteller and conversationalist she also drew people to her. It is from these sources that she drew her desert tales.

Her talents as a writer are present in every description she writes in *The Land of Little Rain*. She paints with words. She reads the landscape. She follows coyote, "your true water witch." She gets down to the "eye level of rat and squirrel kind." She visits with the "pocket hunter," a local miner and the "perfect gossip of the woods." She interprets rock signs and visits the springs they lead her to. She goes to Jimville, a Bret Harte kind of town, and to Las Uvas, a Mexican pueblo. Vivid imageries light up the mind of the reader. As an early naturalist with feminist leanings, and writing long before ecology became a science, Austin was making observations, noting designs and purpose in Nature, making connections that spoke of the interrelationships of living things and the human place in that tapestry.



If you are lucky enough to find an illustrated edition, you may enjoy the line drawings of E. Boyd Smith. They well illustrate the sense of the desert and its inhabitants and are a delightful companion to Austin's perambulations.

So, come. Get out your maps of southern California, Nevada, and Arizona, and follow Austin as she takes her reader on many an adventure through the desert country of this area. In the preface, Austin invites the reader to join her in that timeless land:

> "The country where you may have sight and touch of that which is written lies between the high Sierras south from Yosemite—east and south over a very great assemblage of broken ranges beyond Death Valley, and illimitably into the Mojave Desert....the real heart and core of the country are not to be come at in a month's vacation. One must summer and winter with the land and wait its occasions....if ever you come beyond the borders as far as the town that lies in a fill dimple at the foot of Kearsarge, never leave it until you have knocked at the door of the brown house under the willow-tree at the end of the village street, and there you shall have such news of the land, of its trails and what is astir in them, as one lover of it can give to another."

As a review in *The Dial* (1 December 1903 35:421-2) stated, "The lonely land takes heavy toll of the visitor, but it pays high returns; and once its charm is on you, you may curse it and leave it, but you will surely come back." IWR

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.

Darwin's Ghost
by Steve Jones

New York: Doubleday Books, 2000
377 pp; U.S. $25 (hc)
ISBN 0-385-25903-4

Published in UK under the title
Almost Like A Whale

There can be no doubt that Charles Darwin's *On The Origin of Species* is one of the most powerful and influential books of any generation, past or present. Darwin's theory of common descent has revolutionized the way we look at biology—even the way in which we look at ourselves. It has shaken our beliefs and forever changed our classrooms. Charles Darwin was also a man of wit and keen observation; *On The Origin of Species* is an excellent and entertaining read.

Steve Jones, a British geneticist, is immensely popular with the British media, who have dubbed him the "British Carl Sagan." *Darwin's Ghost* presents a perfect combination: the Steve Jones delivery of the Charles Darwin classic. The book is one of the most informative and entertaining scientific books to be published in a long time. Written in popular style, but nonetheless sticking strongly to the original Darwin text—right down to the chapter and section headings—this book is recommended reading for anyone interested in biology, wildlife, or, for that matter, any of the environmental sciences.

The objective of *Darwin's Ghost* is to re-examine the Darwin classic in the somewhat (although not always) clearer light of twenty-first-century science. The remarkable conclusion is how well Darwin truly stands the test of time. Jones uses very modern examples—the AIDS virus, the rules of the American Kennel Club, even the variations in Chardonnay grapes—to show that Darwin's forceful arguments are alive and well today, and just as poignant and pertinent as they were when the master naturalist wrote them. The further we get from the intrepid *Beagle*, the more we realize that Darwin's ship of discovery has sailed clear into the new millennium.

Beyond Darwin, beyond the wonderful science presented, Jones's book is a truly delicious read. His knowledge of his topic is quite startling, and the clarity and relevance of his examples pure joy. The book is so enticing and entertaining that it is quite easy to forget that Jones has most assuredly done his homework: his research is impeccable, his examples pertinent, and his evaluations of Darwin's ideas in the light of current science are fair and demanding. He doesn't let Darwin off the hook, but Darwin nonetheless survives the scrutiny with flying colors. Darwin's theories weren't always perfect, but they were so in depth, detailed, and far reaching as to seem almost intuitive.

In his opening remarks, Jones states: "Today, his [Darwin's] theory that species undergo modification and are the descendents of pre-existing forms is accepted by everyone—or by everyone not determined to disbelieve it." This book will not do well with people who are determined not to believe in Darwinism. The arguments are too powerful, the facts too overwhelming, and the modern-day proof too compelling. Opponents of the theories of evolution—or descent with modification—oft times use the argument that there cannot be intermediaries between dissimilar species—such as, for example, land mammals and whales. What use would flippers be on the ground, or feet in the sea? Jones adeptly points out, time and again, that the imperfection and spottiness in our geological record is simply not reason enough to disbelieve the obvious: "Evolution is, most of the time, an attempt to reconstruct a history whose pace is far slower than those who study it." The terrible AIDS virus becomes Jones's exception—his example of evolution in real-time, where genes and time come together on a human scale. The virus (as with many viruses, Darwin himself saw disease as a model of change) is proof of descent with modification because we can see it happening.

Rarely has science been so relevant, so exciting. There are no sacred cows in this book; everything is on the table for examination. Jones' cutting humor is most satisfying. On the aforementioned Chardonnay: "They taste much the same, although some are smoky and others redolent of butter, peach or passion fruit—subtle contrasts, but important to those old and rich enough to disguise their favorite drug." While some of our institutions may suffer under Jones' wit, Darwin himself shines through as the genius, the observer, and the man who put it all in perspective.

Jones makes no bones about the fact that he is a ghostwriter for Charles Darwin. He states: "For my own book I can make but one claim: it is the least original of its decade. So sturdy is the model upon which it is based, however, that in this case to be derivative is a strength and not a weakness." Indeed, derivative though it *must* be if it is to be a fair appraisal of *On The Origin Of Species*, Jones' personality, skill, and craft shine through.

The last word should belong to Steve Jones himself: "The new insight that biology gives into our history releases us from the narcissism of a creature that is one of a kind. It shows that humans are part of creation, because we evolved." IWRC

Reviewer Joe MacLeod is on the IWRC board of directors.

Desert Puma: Evolutionary Ecology and Conservation of an Enduring Carnivore
by Kenneth A. Logan & Linda L. Sweanor.

Washington, D.C.: Island Press, 2001
463 pp; U.S. $70 (hc), $45 (paper)
ISBN 1-559-63866-4

The authors' work launches a "flagship" study for the Hornocker Wildlife Institute and emerges as a landmark in puma research and conservation, an epic journey in the pursuit of knowledge of these elusive big cats. The ten-year study from 1985 to 1995 explores the secret life of desert pumas inhabiting the San Andres Mountains of New Mexico. This first long-term intensive study of pumas living in a desert environment is also the largest investigation ever conducted on any single puma population. It encompasses about 9,780 total person days of field research, with capture and release of 241 individual pumas. Tracking the big cats year round by air and ground gives nearly 14,000 radiotelemetry locations, yet this is only a fraction of the total effort and material presented in this monograph.

The scope of this book serves three different audiences. It targets the academic community as an absorbing scholarly treatise. The story is told in twenty-one chapters under five headings: (1) Setting the stage, (2) Puma life history strategies and population dynamics, (3) Puma behavior and social organization, (4) Puma-prey relationships, and (5) Pumas and people. The authors present their data in nearly 100 figures, tables, and plates dispersed throughout the sections, along with analytical and statistical methods. Review of scientific literature includes information on the large cats in general, and compares methods of data collection and analysis between this study and prior studies of the puma and other large felids. The work explains and tests various hypotheses concerning survival strategy and reproductive strategy in relation to population structure and dynamics, prey dynamics, innate puma behavior, habitat, climate, and other aspects of its ecology. Illustrative photographs are given throughout.

Logan and Sweanor's research also serves wildlife managers. The New Mexico Game Commission, to its credit, initiated this study to provide scientific information for field application. The study thus establishes basic biological and ecological findings needed for management decisions to sustain self-perpetuating populations of pumas and their prey, while at the same time balancing the needs of other diverse and vested interests, including recreational puma hunting; hunting of big game (deer), which may compete with the puma for the prey base; protecting endangered desert bighorn sheep; and minimizing puma predation on livestock. Always present is interest to protect humans and their companion animals that may encroach on puma habitat. *Desert Puma* provides important information for the wildlife manager, although some practical aspects of the material may be cumbersome to retrieve due to the book's extensive detail.

A third audience for the book is encouraged as part of a total conservation effort. This may include anyone with some scientific background, an interest in puma or big cat conservation, and the desire to enter the milieu of scholarship to better understand the subject. Many areas of interest are well served, including those of natural resource policy, zoo or mammalian biology, various aspects of environmental study, and broader areas of public education on such issues. The involvement of informed advocates is essential, according to the authors, to help transform the scientific findings of this study into a format the general public can understand and become responsive to. Successful conservation efforts require a broad-based acceptance of our ethical obligation to protect natural systems, combined with widely accepted knowledge based on scientific understanding of how natural systems work. Only then can efforts to protect the big cats from extinction be successful.

It may be hard for anyone other than a field biologist to appreciate the effort and commitment involved in this study. Pumas are among the most difficult of the large terrestrial mammals to study since they naturally shun human contact, have cryptic coloration, and are crepuscular and nocturnal. The only reliable method of study requires tracking, then immobilization and capture of each puma. Each is given individual identification, and all but cubs are fitted with a radio collar. Data are recorded from each animal. After this processing, the subjects are released at or near the site of capture. Movements are followed by radiotelemetry, and fieldwork continues year round, in this case ten days in the field followed by four days in civilization to regroup. Tracking and capturing animals involves many skills unknown to the ordinary researcher. These include map reading, orienteering, rappelling, tree climbing, handling dangerous animals, and living with the privations of life in remote places. Surviving the elements of weather, being lost, hunger, and tiredness are all part of the experience. All of these add to the element of adventure and romance and give epic proportion to this study.

The San Andres Mountains offer an ideal habitat for long-term basic research on pumas. The mountains are part of the basin and range physiographic province, composed of broken narrow ranges flanked by large desert basins. Isolation of the mountains by the surrounding desert basins provides a self-contained ecosystem wherein none of the large mammals migrate seasonally. The land is restricted by the U.S. Army and is relatively undisturbed by humans, minimizing many confounding variables from human activity.

In this study, the scientists' first hurdle was to censor the San Andres puma population using the methods of capture-mark-release and radiotelemetry tracking. They repeated the censor process annually and found the population on average is comprised of 61 percent adults, 6 percent sub-adults, and 33 percent cubs. Population structure and dynamics—including adult home-range characteristics, interactions between pumas, puma social organization, and dispersal (or ranging) behavior—are discussed in several chapters. The researchers found that the San Andres pumas constitute a metapopulation, a network of semi-isolated populations with some level of regular or intermittent gene flow among them. Such populations depend on both emigration and immigration to and from other groups for numeric and genetic augmentation. This structure allows for the best local adaptation to habitat while avoiding the adverse effects of isolation, that of increasing genetic load from inbreeding. In practical terms, it is important for wildlife managers to provide corridors or land linkages to allow contact between localized populations of pumas to maintain genetic diversity and long-term survival.

Several aspects of reproduction are discussed in a chapter that gives information on fecundity rates, natality rates, timing of births, mating system, gestation, birth intervals, sex-ratios of offspring, nursing litter size, puberty, philopatric females, icteroperous females, reproductive behavior, and more. Mortality and survival are discussed in another chapter in which the researchers establish intra-species strife, with pumas killing other pumas, as the dominant mortality factor in the population. (This is not unique to the San Andres pumas.)

An experimental reduction of one part of the San Andres puma population was made in late 1990 to mid-1991 to allow study of population dynamics following a sharp decline in resident pumas in a given area. One section of the study area, designated as the Treatment Area (TA), 703 km. sq., was utilized for this manipulation. Thirteen pumas were experimentally translocated without injury to northern New Mexico. Three others either died of natural causes or disappeared. In all, the resident population of the TA was reduced by 47 percent. The

remainder of the study area was designated as the Reference Area (RA), 1356 km. sq., in which the puma population was not manipulated. The undisturbed RA allowed the scientists to continue observing in an area free of human manipulation. Various aspects of population dynamics in the TA and RA were monitored and compared during the remainder of the study. Much detail is given in the results, but in essence, the population recovered within 31 months. Recruits were from progeny born within the TA, as well as from immigrants from both the RA and from outside the study area. Recruits were basically of the same number and sex as animals removed. This shows the strong influence of mating system and social behavior on puma population structure, and that protected populations can quickly recover from a sudden and sharp decline.

The final two chapters of the book include discussion of overall conservation and management of wild pumas. The authors argue that protected zones of habitat are vital to prevent unnecessary overkill of the puma. Safe corridors or land linkages are needed to allow movement between the protected areas. Empirical data from this study suggest that protected zones should be at least as large as the San Andres Mountains chain, about 3,000 km sq.

The full details of this study add greatly to the richness and fabric of human understanding of an elusive predator, the desert puma. Hopefully this information will be heard. Scientists Logan and Sweanor give us all the elements of an extraordinary adventure story as well. It deserves the wide popular readership enjoyed by the best of the genre of popular animal stories. JWR

Reviewer Bret Snyder, DVM, served as head veterinarian at Albuquerque Biological Park, 1977-2000. He continues his affiliation with the park as a consultant.

This review was first published in the Natural Resources Journal, *Volume 42, #1, Winter 2002. The NRJ is a quarterly publication of the University of New Mexico School of Law.*

NEO-REHABILISM...

inantition

the state resulting from the refusal to eat ants

International Wildlife Rehabilitation Council

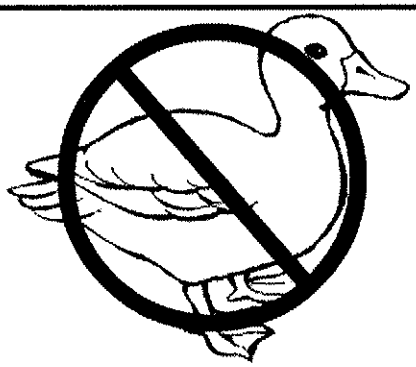
STATEMENT OF REVENUES & EXPENSES

For the year ending December 31, 2001

ORDINARY INCOME/EXPENSES	
INCOME	
Conference revenue	$ 35,447.50
Contributions received	3,564.00
Grants received	44,375.00
Interest income	1,658.40
Legacies and bequests	20,000.00*
Literature income	16,472.98
Membership dues	62,146.00
Sales	425.00
Skills seminars	70,510.35
Standards & accreditation	1,442.03
Total Income	**$ 256,041.26**
EXPENSES	
Administrative expenses	$ 12,930.90
Cash discounts	5.00
Conference program	15,849.47
Equipment rental/lease	4,265.00
HSUS grant expenditure	18,309.22
Ind. contractor fees	29,400.00
Literature program	672.58
Misc. taxes	688.05
Payroll taxes	17,084.53
Postage & delivery	16,487.07
Printing & reproduction	34,434.03
Professional fees	1,795.00
Program expense	9,657.70
Publications	1,403.43
Rent & utilities	10,576.00
Repair & maintenance	907.50
Service fee	939.40
Skills seminar program	20,762.28
Wages & salaries	45,793.62
Total Expenses	**$ 241,960.78**
NET ORDINARY INCOME	**$ 14,080.48**
OTHER INCOME/EXPENSES	
Other Income	
Other income	$ 318.75
Total Other Income	**$ 318.75**
Other Expenses	
Employee investment option	$ 1,375.00
Other expenses	655.20
Total Other Expenses	**$ 2,303.20**
NET OTHER INCOME	**$ -1,711.45**
NET ASSETS: END OF YEAR	**$12,369.03**

**NOTE: $10,000 held in trust for Susan Meredith Fosco Scholarship*

DITTO A REPRODUCEABLE PUBLIC SERVICE ANNOUNCEMENT



If and when baby domestics grow up, they become adult barnyard animals. Do you have a barn, let alone a barnyard? Domestic animals have evolved in the proximity and care of people. They have been bred for the characteristics that humans value, including size, color, and egg-laying capacity. These characteristics may have developed at the expense of independent spirit, fear of predators, and ability to fly and forage successfully. These animals thrive if cared for by people...they fail or are feral "pests" if cast into nature. It is not kind to set a formerly loved pet "free" on an unprotected park pond.

DON'T "PARK" YOUR DUCK!

Park lakes and lake communities do not provide waterfowl feeding programs. Ducks and geese must rely on algae, grass, bugs, and handouts from the public—usually white bread, popcorn, cookies, crackers, and other inadequate foods.

Male domestic ducks can be *very* aggressive. They beat up on females and smaller wild species. Residential lakes are frequently overcrowded, which contributes to avian social strife. Lakes and reservoirs are often culled—i.e., ducks and geese are removed/destroyed—when avian populations become a problem to the neighbors.

Domestic waterfowl, especially discarded pets, lack the necessary skills to survive on a lake. There is fierce competition for food, and less-aggressive birds often starve to death. Ducks raised in captivity can also fall prey to dogs, cats, people, and other predators; they are often not alert enough to detect danger and escape to the water.

Many domestic breeds cannot fly. They don't have the option of leaving an area if food is scarce—and they are also more susceptible to predators if they can't escape by flying.

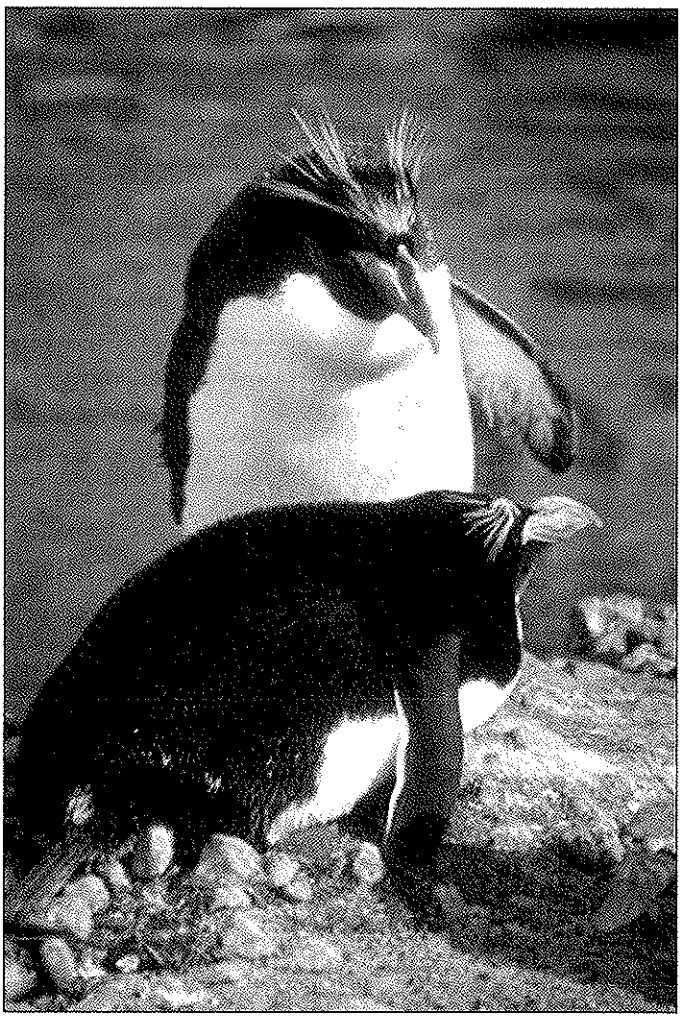
If you don't have a barn...don't even get a barnyard animal!

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

Ditto provided by the East Valley Wildlife Rehabilitation League, Chandler, Arizona

TAIL END

by Astrid MacLeod



Macaroni Penguin (*Eudyptes Chrysolophus*)

Now go to your room!

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 continent of North America.

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). The primary author of each original article published receives either a $30 honorarium or a one-year individual membership or renewal. IWRC retains copyright on all original articles published in JWR, but will grant permission to reprint articles upon request, with credit given to IWRC.

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