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IN THIS ISSUE

Improving Detection of Pesticide Poisoning in Birds, Part II ... Formula for Nestling Songbirds ... Survival and Movements of Translocated Raccoons ... Microminerals ... West Nile Virus ... Living with Pigeons ... Wildlife Education ... Abstracts ... News Updates ... Book Reviews ... Pesticide PSA ... 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: This Dunlin (*Calidris alpina*) was photographed in 2000 on Marco Island just after its rapid death from aerial spraying of fenthion, an organophosphate chemical only registered in Florida for mosquito control. [PHOTO: Ted Below]. BELOW: A new formula for nestling songbirds. [see page 13; PHOTO: Marc Payne.]



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EDITORIAL

A Wake-up Call for Rehabilitators

The terrifying explosion of West Nile Virus (WNV) across North America has everyone involved in public health, veterinary medicine, and wildlife conservation scrambling to assess the impact this newly discovered disease might have on both human and animal populations. In three year's time, from a single case identified in New York, this scourge has spread across the continent, affecting thousands if not hundreds of thousands of birds and other animals. WNV seems certain to be working its way steadily toward Central and South America, where even greater environmental disaster could occur. Conservation biologists are using words like "disaster" and "catastrophe" to describe what may lay in store for wildlife in the Western Hemisphere.

Wildlife rehabilitators in the Midwest United States are being overwhelmed with sick raptors. Diagnostic laboratories are months behind in testing. Zoos and nature centers are losing significant numbers of their collections, and are desperate to stem these losses. Many centers, including my own, the Wildlife Center of Virginia, are using the equine vaccine in an attempt to impart some measure of protection to our education animals.

For wildlife rehabilitators, WNV is a graphic reminder of the need to stay abreast of new knowledge about wildlife disease. While there is a shortage of good information available on WNV, there seems to be *no* shortage of bad, misleading or outright erroneous information out there. Further, while WNV seems likely to be one of the most serious threats to face avian species since DDT, it is not the only threat, and it is not the most common problem being seen, even in the face of the current outbreak. Further, the neurological signs of WNV infection are very similar to those of many other serious problems that could be affecting a bird presented to us for care.

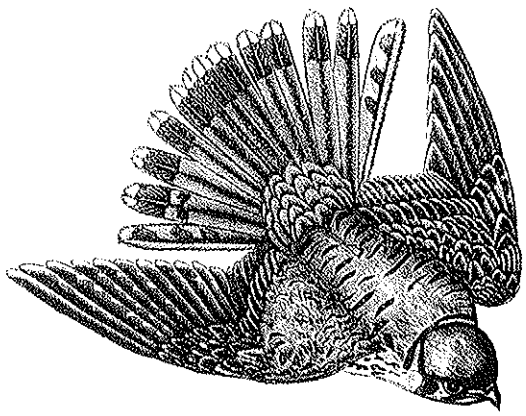
From a casual examination, it could be virtually impossible to distinguish between WNV, pesticide poisoning or head trauma. In fact, of the hundreds of raptors necropsied by the National Wildlife Health Center, 80 percent did *not* test positive for WNV. Wildlife veterinarians and rehabilitators need to resist the temptation to grasp at what may seem like obvious answers and dig for the full story. While there is no known treatment for WNV, pesticide poisoning and trauma *can* be successfully treated. Failing to recognize that neurological signs may not be WNV could prove as fatal to the patient as the virus itself would have been.

This said, many centers will be seeing a lot more WNV cases in the future. The disease is presently moving faster than the epidemiological research. Wildlife rehabilitators will be critical data sources as scientists and wildlife managers try to reconstruct the spread of this disease through retrospective studies. For this reason it absolutely essential that all rehabilitators keep complete and thorough records on all of their cases. It is essential that no diagnosis be assumed unless it has been confirmed, one way or another. Over the next year, studies will be started to try and assess the impact of WNV on raptors and other species. Our community can play an important part in those studies, *if our efforts and our data are up to standard.*

WNV, Chronic Wasting Disease, and other previously unknown diseases are likely to change the face of wildlife rehabilitation. We will have to deal with new problems and new restrictions on the movement, treatment, and release of animals. While most centers deal primarily with orphans and trauma cases today, infectious disease may become more the norm in the not too distant future. More than ever before, our community needs to embrace continuing education, remain current on rehabilitation techniques, and participate in professional development activities, like conferences and training programs. The day is coming when wildlife rehabilitators will be the front lines in the monitoring, detection. and reporting of wildlife disease. We need to be ready.

—Edward E. Clark Jr.
President, IWRC Board of Directors

On Injured Birds and the MBTA, Tryptone for Hummers



I have several times found myself in situations where it was clear to me that a migratory bird was sick, injured, or orphaned and needed to be rescued and taken to a permitted facility. Unfortunately, also on several occasions I have been stopped from doing this with the result being the death of the bird in need of assistance. In these cases, the MBTA is thrown out as the "ultimate" law; since it states that the birds cannot be captured, possessed, or transported by a nonpermitted person, the wording is taken quite literally and the bird ends up dead.

Is there anything in writing anywhere regarding this situation that allows for a nonpermitted citizen to render assistance to migratory birds without threat of jail, citations, or fines?

The Migratory Bird Treaty Act (MBTA) of 1918 is a "strict liability" criminal statute. This means that it is not necessary to prove the intent of an accused nor whether they knew their actions were a violation of law. It is only necessary to prove that the accused knew or should have known they committed the action that is the basis for the violation. For instance: a person who carelessly shoots a gun straight up without looking, just happens to kill a hawk flying overhead, and never sees the bird even as it tumbles to the ground would have violated the MBTA. The same rule applies to a concerned nonpermitted citizen who finds an injured migratory bird, picks it up, and transports it to a permitted rehabilitator. They have also violated the MBTA. We would prosecute the first scenario but not the second.

Neither the U.S. Fish and Wildlife Service (USFWS, the investigators) nor the Department of Justice (the prosecutors) has an explicit nonprosecution policy for "Good Samaritan" acts by would-be rescuers. Rather, the decision to prosecute, or not, relies on the good judgment and common sense of the enforcers. The fear of prosecution for rescuing a migratory bird is unfounded. There is no "parade of horribles" for people who bring birds to your facility. One of the justifications for establishing special purpose rehabilitation permits is for "reasons of human concern for individual birds" (50 CFR 21.27). The FWS does not issue you a rehab permit and then anticipate citing everyone who rescues a bird. If you still need some assurance before acting, simply notify the rehab facility, a local game warden, or some other authority of your intention. Removing a migratory bird from harm's way and taking it to a permitted facility is a legitimate altruistic behavior even though, technically, this is not specifically authorized by the MBTA.

—*Rob Lee*

Rob Lee has been a special agent for the USFWS for fourteen years. Prior to that he served as a refuge manager for USFWS for eight years. For the past year and a half, he has authored a column, "By the Book," that has responded to legal questions from readers of this journal. The editors thank him for sharing his knowledge and insight into the legal issues facing wildlife rehabilitators.

I understand from Penny Elliston and Janine's Perlman's article on hummingbird nutrition (Meeting the protein requirements of adult hummingbirds in captivity. *J. Wildlife Rehab.* 25[2]: 14–19) that unflighted hummers need more protein than I've been giving them, so I wanted to buy some tryptone. I called the company you listed, and a couple of others, too, and they all insisted that I have some kind of organizational or corporate credentials, or they wouldn't sell it to me. I don't understand this, and I'm wondering how I can buy this product as an independent rehabber.

Many suppliers will not sell tryptone to unaffiliated or credentialed individuals.

You might consider forming a buying co-op in which at least one member does have organizational credentials and can do the buying. Another alternative is to buy small amounts (which are all that are required for hummingbirds) from people/centers who have bought it and have some to spare.

You may want to have some extra in your avian pantry, though; since it is pure, predigested protein of high quality, it can be an important addition to an elemental tube-feeding formula for cases of severe illness/emaciation.

—*Penny Elliston and Janine Perlman*

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

{ NEO-REHABILISM... **zoonotes** *critter medical records* }

Improving Detection of Pesticide Poisoning in Birds, Part II

by Pierre Mineau and Kelley R. Tucker

Common Causes of Poisoning and Routes of Exposure

It is useful to review briefly the major causes of bird poisoning incidents. A good understanding by the rehabilitator of the types of pesticide exposure situations that frequently result in poisoning incidents may help him or her suggest a diagnosis for an individual that has been admitted.

The first category to consider is that of **abuse or deliberate misuse of a pesticide** (usually an insecticide but also rodenticides) to kill vertebrate wildlife considered to be pest species. Nontarget individuals, such as avian scavengers, are often killed incidentally. In the United States it is estimated that between 1985 and 1994 about half of all recorded incidents of raptor poisonings with organophosphorus (OP) and carbamate (CB) products were cases of abuse (Mineau et al. 1999). In Canada the proportion of cases resulting from abuse appears to be lower, but this tally is heavily biased toward one specific region where there is a problematic overlap between high wintering populations of bald eagles (*Haliaeetus leucocephalus*) and intensive agriculture. The presence of unusual food material (such as bread, meat of domestic animals, etc.) in intoxicated individuals is often the first indication that illegal baiting has taken place.

Granular insecticides come up time and time again as a source of wildlife pesticide mortality. Many cases have been reported in several countries. The high risk associated with pesticide granules is a result of (1) the high toxicity of several registered products, and (2) current agricultural machinery that cannot ensure that pesticide granules are completely buried below the soil surface or—worse—that deliberately place them on the surface. Poisoning cases can occur through direct exposure because several bird and small mammal species are attracted to granular formulations, especially those that make use of sand (silica) or dried granulated corn cob. The first are likely taken as grit, the latter as food because they resemble seed fragments. Exposure can also occur via invertebrates, especially earthworms or cutworms to which granules may adhere, or secondarily through predators and scavengers that eat their prey whole or ingest their gastrointestinal tract contents. In Canada and the U.S. there have been cases of poisoning of waterfowl foraging in puddles in fields more than six months after pesticide application. Out-of-season poisoning cases are therefore possible with these formulations.

Historically, **seed dressings** were one of the main sources of wildlife exposure to organochlorine or mercury compounds. Poisoning incidents with seed dressings are still relatively frequent, especially in Europe where there is a heavy use of cholinesterase-inhibiting pesticides for this purpose. Lindane (which is an organochlorine insecticide) is the main seed dressing chemical in North America, a situation that is about to change. It will be replaced with a number of products, some of which may be much more acutely toxic.

A group of birds at particularly high risk is grazers such as geese, some ducks, and coots. Grazing birds do not break down cellulose and therefore need to consume large quantities of foliage, which puts them at risk when feeding in sprayed forage crops, pastures, or turf. The use of diazinon on turf is a perfect example. More than 100 cases, some involving hundreds of birds, were recorded on turf before the pesticide was withdrawn from golf courses in the U.S. (Stone and Gradoni 1985, Stone 1987).

Wildlife species that specialize on agricultural pests such as grasshoppers, leatherjackets, grubs and others are at high risk of poisoning. Kills of these species are all the more tragic because such wildlife species are beneficial to agriculture, and they offer a valuable, if often unrecognized, service (Kirk et al. 1996). When highly toxic insecticides are used, especially against irruptive pest species (such as grasshoppers, cutworms, or leatherjackets [crane fly larvae]) opportunistic gorging can get a number of species, including some raptors, gulls, grouse, or songbirds, in trouble. In a

ABSTRACT: Pesticide effects on birds are multiple yet remain poorly understood. We know that birds are important sentinels of ecological health in every environment. Our knowledge of pesticide effects on birds and other wildlife is greatly improved when avian pesticide incidents are properly identified, reported, investigated, diagnosed, and recorded in accessible standardized formats. Properly informed and with resource support, the wildlife rehabilitation community can become a valuable source of information.

KEY WORDS: avian, pesticides, poisoning, organophosphorous, carbamate, anticoagulant, cholinesterase, neuro-toxicity, synapse, 2-PAM, atropine, clinical signs, measurement, monitoring, reporting

PIERRE MINEAU, PH.D., is a research scientist with the Canadian Wildlife Service, Environment Canada and the head of the Pesticide Section at the National Wildlife Research Centre in Ottawa, Canada. He also holds adjunct professor status at McGill and Carleton Universities. He has published widely, given more than 100 scientific presentations worldwide, and has been a consultant to many governmental and nongovernmental organizations in Canada as well as in the U.S., France, China, Argentina, Chile, and Israel.

KELLEY R. TUCKER, M.A., is a conservation science policy analyst specializing in wildlife ecotoxicology issues. She was founding director of American Bird Conservancy's Pesticides and Birds Campaign and has recently joined the staff of Manomet Center for Conservation Sciences. Ms. Tucker—a wildlife rehabilitator and educator who has served on the IWRC Board—is editing a semi-technical volume recommending strategies for advancing research on and assessment of pesticides. Her work also appears in *Fatal Harvest: The Tragedy of Industrial Agriculture.*

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recent case in Argentina, approximately 20,000 Swainson's hawks (*Buteo swainsoni*) were poisoned within the span of a few weeks after feeding on grasshoppers sprayed with monocrotophos (Hooper et al. 1999, 2002).

Poisoning need not be through ingestion of contaminated foodstuffs. The **use of OPs in dormant oils** applied to California orchards has given rise to a large number of raptor intoxications (Hooper et al. 1989, Fry et al. 1998, Mineau et al. 1999, Hosea 2000). It is probable that other species such as goldfinches (*Carduelis tristis*), juncos (*Junco hyemalis*), killdeer (*Charadrius vociferous*), white crowned sparrows (*Zonotrichia leucophrys*), and yellow-rumped warblers (*Dendroica coronata*), present in high numbers (Michael Fry, U.C. Davis, pers. comm.), were also affected. In the case of raptors, however, exposure is thought to have come primarily from dermal contact with branches and other sprayed surfaces.

Finally, some poisoning cases result from the **use of organophosphorous pesticides for the treatment of ecto- and endoparasites in livestock.** The most interesting case is undoubtedly that of famphur as documented by Henny and colleagues (1984, 1985). Famphur was found to persist on the hair of cattle and cause poisoning of magpies (*Pica pica*) up to 100 days after treatment. Famphur remains one of the leading causes of eagle poisonings in the American Southwest. Author K. R. T. has detailed elsewhere pesticides that provide the greatest hazards to birds and remain registered for use in North America (Tucker 2000).

Identifying Pesticide Incidents

Our knowledge of pesticide effects on birds and other wildlife is dependent on the number and quality of incidents that are identified, reported, investigated, diagnosed—through necropsy, biochemical, and/or chemical testing—and recorded in an accessible and reliable format. Unfortunately, fully documented incidents are rare when considered against current estimates of lethal and sublethal pesticide effects on birds. A recent modeling exercise (Mineau 2002) suggests that bird kills are frequent and largely unavoidable with many pesticides registered currently. Kills have been recorded that implicate more than 50 pesticide active ingredients registered in the U.S. (USFWS unpublished). It is likely that documented cases represent only a small fraction of total pesticide mortality among birds (Vyas 1999). There are many reasons for this. Foremost is the difficulty of finding birds that have died or are inhibited by pesticides. Birds are small, many are cryptically colored and, once dead, they are often difficult to detect in open fields, park areas, or dense brush. Research shows that, on average, 77% of all carcasses are destroyed or removed by predators within 24 hours (ibid). Birds exposed to sublethal effects of pesticides may become disoriented or lethargic and may seek cover in dense brush or in cavities or holes of other species. The mobility of birds also adds to the difficulty of identifying incidents. Birds that receive lethal doses of pesticide can, in many cases, fly some distance—sometimes several miles—from a poisoning site prior to any significant impairment.

As noted in Part I of this paper (*J. Wildlife Rehab.* 25(2): 4–13), pesticide exposure that is not immediately lethal can impair a variety of avian functions and may lead to death or injury via predation, car strikes, starvation, or another such secondary event. In such instances, the recorded cause of death or the course of treatment often focuses on the secondary hazard, not the intoxication that created the bird's initial vulnerability. As reviewed earlier, efforts to measure cholinesterase levels or anticoagulant loads in injured and dead raptors at wildlife centers suggest that exposure to these pesticides may increase a bird's vulnerability to further injury via predation, accident, or other causes.

Rehabilitators and wildlife professionals are becoming increasingly aware of the effects of pesticides but are frustrated by the lack of access to testing, the shortage of federal and state resources to handle suspect cases, and the lack of a reliable centralized source for information and guidance on standard procedures and comparative references for diagnosing, treating, and reporting pesticide poisoning in birds.

The Avian Incident Monitoring System (AIMS) was developed to resolve many of these issues. AIMS is a comprehensive program, overseen by the American Bird Conservancy (ABC), to monitor, identify, diagnose, and report field effects of pesticides on birds in the U.S. and Canada. As originally designed, AIMS includes an electronic data system for sorting and sharing avian incidents nationally and internationally; incorporates historical data from paper and electronic files; and creates state/province-based programs that provide training, infrastructure development, and—when needed—outside resources to enhance monitoring, diagnostic, and reporting capacities (Tucker 2001).

As part of the wider AIMS project, a one-year methods validation and trial of a proposed national network is underway at the Patuxent Wildlife Research Center (PWRC) in Laurel, Maryland, with funding from the U.S. Environmental Protection Agency and critical support from PWRC staff, ABC, National Wildlife Health Center, and U.S. Fish & Wildlife Service. Several U.S. avian rehabilitation centers are participating as partners in the trial. If successful, and implemented at a regional or national level, the Avian Pesticide Incident Network (APIN) will provide permitted rehabilitators and wildlife professionals with access to screening and diagnostic resources so they can verify avian pesticide incidents that might otherwise go unrecorded because of cost or lack of resources. The APIN trial and proposed program expansion will provide additional information on clinical signs, diagnosis and treatment, observations on species- or chemical-specific responses, opportunities to verify and compare methods of detecting and measuring pesticides, and insight into how and when pesticides play a contributing role in addition to a direct role in mortality or impairment.

Why Incident Monitoring?

Pesticides are registered for use in a specific situation, for example on lawns or specific crops, in forestry, gardening, or the home. Federal environmental agencies responsible for evaluating the risk and efficacy of each registration require a battery of tests be performed on the principle or "active" ingredient. The vast majority of these tests are conducted in the laboratory, primarily to gauge potential human effects. Testing for effects on wildlife species and parts of the wider environment is limited. For example, only two bird species are required to be tested. Independent research has proven that

there are vast differences in sensitivity from one bird species to another—and among individuals within species. Testing scenarios are highly controlled and do not account for variation between species, routes of exposure (e.g., dermal and inhalation in addition to the oral route), or differences in the health or general condition of animals that will be exposed in normal use patterns. The chemical behavior of pesticides can also be altered by local conditions, such as soil type and weather. Even if testing in controlled scenarios is extensive, unforeseen problems can arise once the product is released for registered commercial use. Specific species of birds not tested in the laboratory may show particular sensitivity to a compound in the field; the formulated product (the tested active ingredient plus other chemicals ingredients added for efficacy) may behave differently in a particular field scenario; or combinations of different formulated products, via sequential spraying or deliberate mixing of different compounds in the same area, may result in hazardous combinations not predicted in the laboratory. Scientists, policy analysts, and regulators are attempting to develop risk-assessment models that can take some of this variability and uncertainty into account. But without the dedication of resources to a greater number of preregistration field trials, ongoing scientific field research, or postregistration processes for assessing impacts in actual use scenarios, our understanding of pesticide effects on birds and other taxa will continue to be minimal.

Incident monitoring is one of the critical mechanisms by which unanticipated hazardous toxic effects resulting from registered, everyday use of pesticides can be recorded and reported—and in the end, mitigated or a specific use pattern cancelled. Effective incident monitoring requires trained and authorized personnel to search for, identify, and investigate wildlife incidents. In North America, at a national and international level, no formal avenues exist for reporting sightings of dead and injured birds that may be victims of pesticide exposure. The lack of formal or informal monitoring systems does not suggest that few problems exist, but ensures that much goes unobserved; that when incidents are observed they are not often reported; and that even when they are reported, they often remain uninvestigated due to a lack of resources, training, or readily available standards. The relatively small numbers of incidents that are reported, investigated, and diagnosed are the tip of the iceberg in terms of actual numbers poisoned.

In the Meantime: Guidelines for Rehabilitators

Until APIN is rolled out region-by-region, or a national monitoring system is up and running in each state and province, rehabilitators can contribute to the understanding of pesticide impacts and increase their accuracy of diagnosis and treatment by following standard procedures and documenting possible pesticide cases. The following guidelines should be considered a minimal procedural outline to be augmented by protocols or suggestions from state/province or federal authorities in an area or a particular diagnostic lab handling any collected samples. Rehabilitators in the U.S. and Canada should establish working relationships ahead of time with state/provincial and federal biologists and enforcement personnel in their area to ensure that any carcasses or site information collected can be easily incorporated into existing records and procedures. As is true with all care issues, the ongoing involvement of qualified veterinarians is critical to diagnostic capacity and the identification of resources for optimal response to pesticide incidents.

Incidents in the field

If a wildlife rehabilitator or wildlife professional identifies an avian mortality incident, they may choose to retrieve carcasses and investigate the site. One motivating reason for doing so is the fact that, on average, carcasses are removed quickly and/or destroyed by scavengers, and time is of the essence for gathering meaningful data. Remember that, without appropriate storage conditions, carcasses become less useful for diagnostic purposes as time elapses. Please note that regulations covering these activities vary from country to country and you may be required to gain specific permissions. Consult the relevant government agency for details prior to conducting any such activities.

Once you take on the responsibility of investigating an incident, take the time to follow some basic procedures and document all observations. Any kill could become a formal investigation, and you may be the first or only person on the scene. The following generally applies to any incident.

- Be inquisitive, thorough, and safe.
- Do not assume that a pesticide is the cause; expect the unexpected—awareness of recent wildlife disease incidents in an area may affect your decision to collect.
- Assume that the incident may become evidence for a regulatory decision, focused monitoring efforts, or a legal case.
- Take common sense precautions, wear gloves, double bag all carcasses, be aware of fumes that might accumulate in the car or other enclosed space where carcasses are temporarily stored, and think twice about removing any bird from standing water—it may be difficult to avoid being exposed.
- Do not enter private land without landowner permission.
- Contact state/provincial and federal authorities immediately, whether you feel competent to collect and/or investigate, or not.
- Rehabilitators who carry emergency response kits may want to add the following items: several sizes of sturdy, self-sealing plastic bags; sturdy plastic disposable gloves; compass; camera; 3"x 5" index cards; paper, pen, and pencil.

Documenting the site

The following elements are fundamental to a good site investigation. Observations on land use, proximity to water, weather, and other variables can be critical to identifying and verifying the reason for an incident. Record as much data as time and circumstances warrant. Include the following:

- **Description of the area:** specific location; land use immediately surrounding the carcass(es) and beyond; habitat. Draw a map with compass points that indicates tree stands, bodies of water, roads, and other physical features.
- **Environmental factors:** storms, precipitation, changes in temperature or other factors that might play a role in the condition of the bird or other physical evidence.

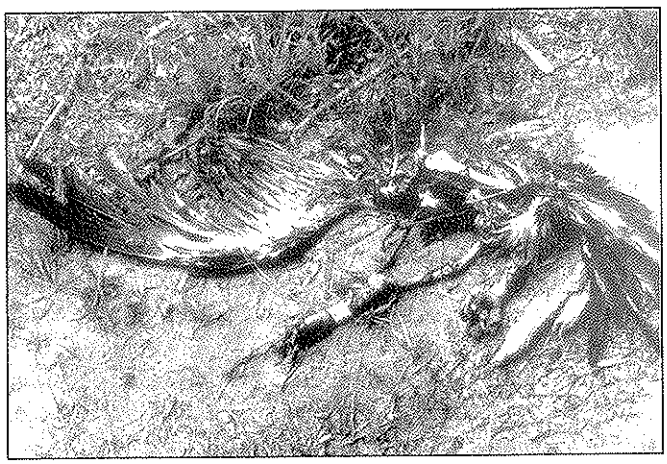
- **Chronology:** estimates of the order of events, including any known application of pesticide; arrival of birds in an area; onset and/or duration of clinical signs.
- **Organisms affected:** species, number of individuals per species (if an estimate, describe your method of estimation), age, sex, overall appearance.
- **Clinical signs:** any usual behavior or physical appearance (e.g., lethargy, fearlessness, drooping wing or neck, seizures, etc.).
- **Populations at risk or present:** species using, moving through, or known to regularly inhabit the area.
- **Take photographs** of the site and of carcasses when possible.

Collection, transport, and storage

Established relationships with wildlife laboratories, local authorities, veterinarians, or other organizations with experience working with pesticides and birds may affect decisions regarding whether, when, and how to collect and store evidence from incidents that might be identified. As a general rule, when the incident is limited to one or only a very few known carcasses, it is best to collect all of them if supplies are available. Remember that the longer a carcass decays or is subject to scavenging or exposure to heat and other elements, the less use it will be in the diagnostic process. Carcasses should be handled minimally and with disposable gloves. After scanning a site and noting some of the information above, document the site with photographs, including the wider site in which the carcass(es) are present and closer shots detailing the position of the carcass(es). Before collecting, prepare an identification tag to be attached to the bird by string or wire or inserted into the interior self-sealing plastic bag. Information on the tag should include your name, address, phone number or other contact information (these could be preprinted), collection site, date, and species. Note whether the bird was found dead or any clinical signs apparent prior to death. After sealing bag with the tag inside, place this bag into a second self-sealing bag. Double-labeling, placing a duplicate second card in the outside bag, is often worth the extra time. Use a soft lead pencil or permanent ink pen.

Transport carcasses quickly to an appropriate prearranged storage facility. Consider the possibility of fumes, keeping carcasses in a well-ventilated area during transport. Rehabilitators are already aware of the various reasons for separate cooling and freezing units in their work. At minimum, clearly labeled, limited access, partitioned areas in units set aside for double-bagged carcasses only, should be maintained for any potential pesticide incident storage. If the storage site for carcasses is owned or managed by another individual or agency, have the transferee fill out another 3"x 5" card with their name and contact information and the date of transfer, and insert this into the outside bag of all carcasses involved. Keep a record of this transfer in your notes for the incident.

Deciding how to store carcasses requires consideration of the contradictory demands of necropsy versus chemical and biochemical analysis noted above. For the former, the bird should be keep cool but not frozen; in the best case scenario for chemical and biochemical analysis, the carcass should be frozen immediately, preferably in a stable ultralow freezer. Ultralow storage allows rapid freezing of carcasses and maintains a stable low temperature. Once frozen, any thawing or refreezing—including the natural defrosting process in most home units—will compromise chemical or biochemical analysis. Again, rehabilitators working with experienced partner laboratories or agencies can receive some guidance in making these decisions. If multiple carcasses in good condition are available from one site, split them up, freezing some for analysis and keeping others cool for necropsy. While chemical and biochemical analyses are often key to diagnosing OP and CB pesticides, a carefully conducted necropsy may reveal important information about the incident, including evidence of other pesticides such as rodenticides.



DON PATTERSON

This bald eagle was located just after death by a USFWS agent, marked, and purposefully left in the field. Twenty-four hours later, at the time of this photo, its scavenged carcass is difficult to locate, identify, and leaves little, if any, evidence for pursuing pesticide analysis.

Necropsy, biochemical, and chemical analysis

This paper will not address specific protocols for necropsy and biochemical and chemical analysis. Numerous valid procedures exist for any one of these protocols, but standards for ensuring comparability and consistency in data collection are lacking. The APIN trial described above will validate protocols for diagnostic processes agreed on by a working group, including scientists from numerous federal agencies, academia, nonprofit science, and conservation groups and industry. Once validated, these protocols will be made available to practitioners through publications and other fora.

If your reporting does not result in federal or state/province involvement in the case, you may choose to necropsy or have the bird necropsied and submit samples to a laboratory. In addition to common necropsy procedures, other aspects germane to pesticide investigations include using sagittal sections if dividing the brain; removing upper GI tract (stomach and crop contents and stomach, esophagus/crop), bagging or placing these in a glass jar (preferably chemically cleaned and sterile), and freezing as quickly as possible (preferably in an ultralow freezer); and making careful notes on crop or stomach contents identifying and describing seeds, granules, foreign substances, dyes, insects, and other notable material.

If you choose to pursue necropsy, biochemical, or chemical analysis, contact APIN trial staff or the National Wildlife Health Center in the U.S. or the Canadian Cooperative Wildlife Health Center in Canada for further information.

Live birds

Part I of this paper addressed the treatment of birds intoxicated by OP and CB pesticides or by anticoagulant rodenticides. Birds found alive but incapacitated on a site where pesticide poisoning may be implicated or that exhibit clinical signs of OP/CB poisoning on admission can also be tested for ChE inhibition. A sufficient amount of blood must be collected to allow repeat analyses: initial, spontaneous reactivation, 2-PAM reactivation, etc. Once the bird is stable, or as part of the intake exam, draw enough blood to fill at least two (and ideally four) 80–100 microliter tubes. On larger birds the maximum amount of blood necessary will be 1.0 milliliter. For birds under 30 g the assay will require the maximum amount of blood that can be drawn—10% of blood volume or 1% of the bird's body weight. It is ideal to use 80–100 microliter tubes because a single one is sufficient for an analysis, allowing the other(s) to be kept frozen until analyzed. Centrifuge and chill these at –34.44° C (–30° F) or below. These tubes can be submitted for ChE testing to a laboratory with experience in testing avian samples. See the National Wildlife Health Center guidelines for shipping or contact APIN trial staff for details. Consider repeating this blood draw procedure twice more at three- to four-day intervals if the condition and stress level to the bird allows. Also, repeat the blood draw procedure just before release. As noted above, serial sampling of blood can be invaluable to gain more knowledge of the behavior of OPs and CBs in specific species and individuals.

If crop contents on larger species can be removed with minimal stress, remove, double-bag (or use a chemically cleaned and sterile glass jar), and freeze contents following the same relevant safety and temperature protocols as for carcasses. Analyzing crop contents for signs of dye, pesticide granules, or potentially contaminated food sources and pesticide residue can provide compelling evidence of pesticide exposure. Make written notes about the contents when removed and add these to any observations of the site. As noted above, removal of crop contents may also alleviate a source of ongoing intoxication in live birds.

Ethanol foot washes of birds exposed to pesticides can also provide samples for residue testing. Blood, crop contents, and foot wash protocols have been developed for use in the APIN trial and, once validated, will be made widely available.

Shipping

In the majority of cases, rehabilitators will be asked to ship samples (carcasses, blood, etc.) as soon as possible to the laboratory of the agency or organization with which they are cooperating. Remember to always coordinate the shipper, rate, and arrival time with the laboratory staff, as timing is critical to receiving samples of the highest quality. In cases where necropsy is a next step, the use of blue ice (chemical ice packs) is recommended as a refrigerant since they are less likely to leak once thawed. Carcasses must be kept dry and equally cold during shipment. Dry ice will freeze samples so is inappropriate except where freezing is desired. Again, discuss refrigerants with the laboratory with which you are working. Packaging and shipping protocols are available from APIN trial staff and from the National Wildlife Health Center.

Reporting and recording

While appropriate response techniques are critical to the quality of investigative and diagnostic results, they will be in vain unless each rehabilitator keeps detailed records of any incident to which they respond. Even when a rehabilitator is working with qualified personnel from other agencies, their observations in the field or, more likely, of an avian victim may be of great assistance in an investigation. Notes should be kept throughout the incident and recorded as much as possible during the investigation while observations are fresh in the mind and unaffected by later assumptions or findings from the incident. Guidelines and forms for recording information have been compiled by numerous agencies and APIN trial staff.

As soon as circumstances allow, rehabilitators should report incidents to relevant authorities. A listing of federal agencies and resources can be found in the Appendix at the end of this paper. Again, establish a working relationship with state and federal conservation, fish and game, and/or law enforcement authorities in your area. See the sidebar for telephone contact information.

Conclusions

An incident monitoring program requires a network of trained individuals capable of carrying out investigations in the field and collecting and properly identifying and storing samples; access to laboratories equipped for biochemical and chemical analysis and familiar with relevant wildlife protocols; and, in the end, a system for storing and providing access to gathered information. Monitoring can be passive or voluntary, active and highly systematized (thus requiring significant time and a specific geographical focus), or lie somewhere in between, but each system requires that investigative and diagnostic tools and resources are available when an incident is identified and reported. Partnerships among agencies and organizations that are concerned with avian mortality and/or with pesticide effects can bring the maximum available resources to bear on incidents. Coordination of collection activities, investigative and diagnostic procedures, and agreement on a range of procedural standards is essential to produce and maintain a body of high-quality, scientific data that can influence pesticide practice and regulation. Wildlife rehabilitators are well placed to assist in these efforts, and programs are being developed that will provide guidance and resources for those who choose to contribute the additional time and energy required to pursue pesticide diagnoses.

Carefully developed and implemented, the usefulness of an incident monitoring system will increase as the quality, coverage, and reliability of the reports increases. The benefits of such systems are obvious for individual birds, scientists concerned about specific species, and advocates seeking additional information on a particular pesticide. They extend as well to farmers, state officials, regulators, pesticide applicators, land managers, and pesticide manufacturers. All are invested in, can be informed by, and respond constructively to well-documented effects of pesticides in the field. Monitoring

systems such as AIMS seek to share information broadly in order to effect informed decision making. Incident data can be used to validate assessments made in registration; trigger review of a particular pesticide use; improve label directions; focus more systematic field monitoring to further isolate and, hopefully, solve problems.

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APPENDIX A. FEDERAL AGENCY CONTACTS

Staff at many of these agencies may be able to assist rehabilitators in investigating or diagnosing an avian pesticide poisoning incident. Be aware that agency funding is limited, and certain species, geographic locations, or circumstances may have priority. In the U.S. rehabilitators are required to report suspected pesticide poisoning to their regional U.S. Fish and Wildlife Service (USFWS) permit examiner. In a case involving possible criminal activity (i.e., intentional misuse of a pesticide), endangered species, or a repeating pattern of abuse, contact the USFWS law enforcement office closest to you and in your USFWS region. Remember that state and federal law enforcement officers may choose to investigate any poisoning incident, and well-documented rehabilitation records and observations can be invaluable to an investigation. Other possible sources of diagnostic support include the National Wildlife Health Center and the regional USFWS Contaminants program office. These agencies deal with a wide variety of contaminants-related issues, but may have a particular interest or program that will allow them to pursue a situation reported by a rehabilitator. In Canada, the Canadian Cooperative Wildlife Center maintains a hotline and has three regional offices that may be able to provide varying levels of support to rehabilitators. These are only federal contacts; many states have excellent contaminants personnel who can provide information and support on these and related issues.

United States Fish & Wildlife Service

Division of Migratory Bird Management, Regional Contacts (Permit Examiners)

Region 1 (WA, OR, ID, NV, CA, HI, GU, Pacific Islands)	503/872-2715
Region 2 (NM, TX, AZ, OK)	505/248-7882
Region 3 (MN, WI, MI, MO, IL, IN, OH)	612/713-5436
Region 4 (NC, SC, GA, FL, TN, AR, LA, AL, PR)	404/679-7070
Region 5 (ME, VT, NH, MA, NY, NJ, DE, MD, WV, VA)	413/253-8641
Region 6 (CO, UT, KS, NE, WY, MT, ND, SD)	303/236-8171
Region 7 (AK)	907/786-3693

Division of Law Enforcement, Senior Resident Agent Offices
Contact the office in your USFWS region closest to location where bird was found.

Mesa, AZ	480/835-8289
Torrance, CA	310/329-6399
Sacramento, CA	916/414-6660
St. Petersburg, FL	727/570-5398
Miami, FL	305/526-2610
Atlanta, GA	404/763-7959
Honolulu, HI	808/541-2681
Boise, ID	208/334-1684
Derby, KS	316/788-4474
Slidell, LA	504/641-6209
Baltimore, MD	410/962-7980
Charlestown, MA	617/424-5750
Ann Arbor, MI	734/971-9755
St. Paul, MN	651/778-8360
Jefferson City, MO	573/636-7815
Jackson, MS	601/965-4699

continued on next page

Billings, MT	406/247-7355
Newark, NJ	973/645-5910
Albuquerque, NM	505/346-7828
Valley Stream, NY	516/825-3950
Raleigh, NC	919/856-4786
Oklahoma City, OK	405/608-5251
Wilsonville, OR	503/682-6131
Pierre, SD	605/224-1001
Houston, TX	281/442-4066
San Antonio, TX	210/681-8419
Ogden, UT	801/625-5570
Richmond, VA	804/771-2883
Redmond, WA	425/883-8122
Casper, WY	307/261-6365

Division of Environmental Quality, Contaminants Program

Region 1 (WA, OR, ID, NV, CA, HI, GU, Pacific Islands)	503/231-6172
Region 2 (NM, TX, AZ, OK)	505/766-2914
Region 3 (MN, WI, MI, MO, IL, IN, OH)	612/713-5426
Region 4 (NC, SC, GA, FL, TN, AR, LA, AL, PR)	404/679-7127
Region 5 (ME, VT, NH, MA, NY, NJ, DE, MD, WV, VA)	413/253-8659
Region 6 (CO, UT, KS, NE, WY, MT, ND, SD)	785/539-3474
Region 7 (AK)	907/786-3483

United States Geological Survey, Biological Resources Division
National Wildlife Health Center

Wildlife Disease Specialists

Grace McLaughlin	608/270-2446
Kim Miller	608/270-2448

Canadian Cooperative Wildlife Health Center

Headquarters: Saskatoon, Hotline	800/567-2033

Regional Offices

Guelph	519/823-8800, ext. 4556 or 4557
Quebec	450/773-8521, ext. 8346
Prince Edward Island	902/566-0667 or 902/566-0959

APIN Trial Contact

APIN Trial Coordinator

Shannon Borges	301/497-5732

Formula for Nestling Songbirds: Down Payment on Fitness and Survival

by Diane Winn

ABSTRACT: To support their rapid growth, nestling passerines require food containing a high level of animal protein, such as is found in insects. Birds raised experimentally on lower-protein foods have reduced survival rates, possibly due to compromised immune function; those that do survive can be permanently stunted and disadvantaged. Some handrearing formulas traditionally used in rehabilitation settings appear to have inadequate protein levels; MacDiet (MacLeod and Perlman 2001) is an example of a food that approximates the macronutrients of insects. Another example, FoNS (Formula for Nestling Songbirds), is presented in this paper. At Avian Haven (Freedom, Maine), birds raised on FoNS had significantly higher survival rates than those raised on older-generation formulas with lower protein levels.

KEY WORDS: passerine or songbird nutrition, hand-rearing formulas, avian growth requirements, protein levels, nutrients in insects

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Introduction

Altricial birds are one of the fastest-growing vertebrates; they grow 5–6 times faster than mammals of similar adult body size (Ricklefs 1968, 1973). Most small passerines achieve their full adult size within only 10–20 days of hatching (McCarty 2001), and nestling nutrition is one of the most important factors affecting growth (Johnson 1993). Regardless of the diet of the adults they will become, young birds are almost always raised on foods rich in protein (see, e.g., O'Connor 1984); for most passerines, those foods are insects (Gill 1995; Klasing 1998). Experts on avian development have recognized the inadequacy of grains for meeting the needs of growing birds; the amino acid profile of most plant foods is not a good match to that required to support nestling growth (Ricklefs 1983). As noted more recently by Klasing (1998): "The amino acid balance of insects relative to the requirement of birds is almost as good as vertebrate prey and much better than plant proteins" (p. 74). As has been noted by many authors (see, e.g., Studier and Sevick 1992 and several studies cited in Klasing 1998), insects do not provide sufficient calcium to support bone growth, so parent birds supplement insects with sources of calcium such as bone fragments and eggshells.

In the wild, a plentiful supply of insects cannot always be guaranteed. Food quantity limits the survival of nestlings (see Martin 1987 for a review). When the most desirable foods are not readily available, parents may choose lower-quality items that ensure short-term survival of their chicks (Wright et al. 1998). Poor-quality food may satisfy immediate energy needs, but fails to provide nutrients such as amino acids required for growth; over a longer period of time, chicks may not survive, or, if they do, may not attain normal adult size and weight (Schew and Ricklefs 1998). Size and weight are considered to be traits linked to fitness; these stunted fledglings have a reduced probability of survival (Gebhardt-Henrich and Richner 1998). They also may be unable to defend territories or attract mates (McCarty 2001). Metcalfe and Monaghan (2001) note that, in addition to the effects on growth rate, "nutritional deficits experienced during early development can have profound, pervasive, and permanent effects on the adult individual, and even on its offspring" (p. 254).

Research has demonstrated the costs of poor-quality food during development. Johnson (1993), for example, fed nestling house martins (*Delichon urbica*) pork fat in order to reduce their intake of insects while still satisfying their daily energy needs. At day 20, fat-fed and control nestlings (fed insects estimated to be about 65% protein and 9% fat) weighed about the same, but the growth of the fat-fed birds was slower as measured by all other growth parameters: wing chord and the lengths of keel, tarsus, head, and bill. Fat-fed nestlings fledged later than their insect-fed counterparts and were thus considered disadvantaged.

In several studies involving captive zebra finches (*Poephila* or *Taeniopygia guttata*), investigators manipulated the amount of protein available for parents to feed young. Boag (1987) prepared differing-quality nestling mixes by varying the proportions of ingredients such as grain cereals, dry dog food, and meat powder. Birds were assigned to one of three treatments: a mix with 35% protein (plus hard-boiled egg every other day); a mix with 24% protein (plus egg once a week); or a high-carbohydrate mix with 7% protein (and no egg supplements). Diet had a clear effect not only on growth rate but also an apparently permanent effect on size; the groups were still different in mass and tarsus length at 1 year of age.

DeKogel (1997) limited protein in a somewhat different way; the brood size of zebra finches was manipulated by moving eggs just starting to hatch into other nests to create small (two birds) or large (six birds) broods. In addition to a seed diet available *ad libitum*, each family was supplied with a standard amount of an "egg mixture"

containing about 20% protein; in large broods, much less of the egg mixture could be fed to each of the young. Offspring raised on the lower-quality diet were lighter and smaller than their counterparts in smaller broods. As in the Boag study, some of these differences persisted into adulthood. In addition, both during and after their dependence on their parents, the mortality of birds raised on the lower-quality diet was higher than that of their counterparts; in other words, birds that had been smaller as nestlings were more likely to die as adults than those that had been larger as nestlings. Mortality rates were the highest for small female birds. DeKogel speculated that, as had been demonstrated in other species, early diets that are low in protein may have negative effects on immunocompetence. For example, a study by Lochmiller, Vestey, and Boren (1993) found that juvenile northern bobwhites (*Colinus virginianus*) fed diets with protein levels lower than recommended for their age not only showed retarded growth but also negative effects on a number of measures of immune system function.

Support for a connection between immune function and diet came from a third study on domestic zebra finches, this one conducted by Birkhead, Fletcher, and Pellatt (1999). Adult finches reared offspring on a seed-only diet (about 12% protein) or a seed diet supplemented daily with hard-boiled egg (42–45% protein in total dry matter). Chicks reared on the seed-only diet not only grew more slowly but had a significantly reduced cell-mediated immune response. Further, over 500 days posthatch, birds raised on the lower-protein diet had a mortality rate more than double that of their counterparts raised with protein supplements. The authors noted no obvious disease as causing deaths, but suggested that immune function may have some impact on longevity.

A study of starlings (*Sturnus vulgaris*) on a farm site by Wright et al. (1998) lends further support to the findings summarized above. Like deKogel, Wright et al. manipulated brood size by swapping chicks to create experimental brood sizes ranging from three to seven birds. They were able to monitor the food delivered to the chicks by means of "neck collars" that prevented the birds from swallowing food, which was then retrieved from their throats. Results revealed an effect of brood size on type of food the chicks received; those in larger broods were fed a higher proportion of earthworms (considered inferior to larvae in macronutrient and energy content because of the greater proportion of indigestible soil per gram of food). Nestlings in the smaller broods achieved significantly greater weight than their larger-brood counterparts; also, the dates on which they were last sighted around the colony were later, suggesting that they may have survived longer than their larger-brood counterparts.

The subtitle of Metcalfe and Monaghan's (2001) article, "Grow now, pay later?" captures, in just a few well-chosen words, a question all rehabilitators should ask about the consequences of their diets. The *quantity* of food available in rehabilitation can meet or exceed that provided by the parents, but the *quality* of the food we provide may be well below what is required for optimum growth and development. In the sense that insects are the foods chosen by almost all passerine parents for their nestlings, insect macronutrient levels may be said to set a standard for quality, particularly in the case of protein.

One way to determine how much protein an insect-replacer formula should have is to estimate how much protein an "average" insect contains. Insects vary considerably in their protein levels, both among and within species (depending on developmental stage). Barker, Fitzpatrick, and Dierenfeld (1998) measured protein levels in a variety of invertebrates commonly fed to captive wildlife (mealworms, crickets, waxworms, fruit flies, and earthworms); extrapolating from their data set, the average protein content (with means taken first for species within orders, and then across orders) is 46%. Obviously, a much wider range of insect species is available in the wild; an average protein % across a broader base might be somewhat higher (see Appendix for more details).

MacLeod and Perlman (2001) compared their estimates of the macronutrients of insects with those of formulas commonly used in rehabilitation. As noted in this important paper, the grains in the baby cereals and canine foods used in older-generation formulas result in diets that are too high in carbohydrate and too low in protein relative to the needs of growing birds. Some formulas with higher protein levels derive a significant amount of their crude protein from the amino acids in grains or other plants and thus seem better than they really are when amino acid profiles are considered. The commercial product that provides the best starting point for a nestling passerine formula is one designed for a growing carnivore: kitten food. To this base, MacLeod and Perlman recommend adding ingredients that are high in animal protein but low in fat and carbohydrate. Their "MacDiet" was presented as an example of a rehabilitation diet formulated to approach the nutritional needs of developing songbirds more closely than older formulas. On a dry-weight basis, it is 45% protein, 20% fat, and 28% carbohydrate.

Method

Avian Haven (Freedom, Maine) was founded in early 1999; in the two years prior to the 2001 summer season, nestlings in our practice were raised on older formulas based on dog or puppy kibble with added grains (wheat germ, baby cereal, etc.) and egg; they provided, on the average, about 30% protein, 20% fat, and 44% carbohydrate (on a dry-matter basis). In 2000, some birds in our practice were given another popular formula composed of high-grain cat kibble and chicken baby food: overall 35% protein, 23% fat, and 33% carbohydrate.

A colleague sent us a copy of Klasing (1998) late in the 2000 season; we learned of MacDiet at about the same time—first in Internet discussions, and then at a conference presentation. We were impressed with MacLeod and Perlman's logic and decided to use a higher-quality handrearing formula in the coming season. However, the preparation time required for MacDiet seemed impractical; further, in our experience, formula with added dried insects could spoil quickly. We wanted a formula that was more "user friendly," even if it lacked the amino acids and micronutrients of dried insects.

In the winter of 2001, following the principles described by MacLeod and Perlman, I developed another example of a "new generation" passerine handrearing diet: Formula for Nestling Songbirds® (FoNS®). Like MacDiet, it is based on kitten kibble with other ingredients added to raise protein and lower fat and carbohydrate levels. By dry weight, FoNS® offers 46%

protein, 22% fat, and 23% carbohydrate. The specified brand of kitten kibble, Eukanuba®, appears to contain a higher proportion of animal:plant protein than other commercial products. Additional animal protein of avian origin is provided by dried egg white (a more convenient addition than hard-boiled egg white) and a relatively low-fat brand of chicken baby food. Calcium comprises 1.9% of the formula, and the Ca:Phos ratio is the 2:1 proportion considered (see, e.g., Klasing 1998) optimum for bone growth. Preparation instructions and additional information about the ingredients are given at the end of this article. The basic recipe makes approximately 500 cc (roughly 2 cups) of formula at a cost of approximately U.S.$2.35.

In 2001, passerine (and other insectivorous) hatchlings and nestlings at Avian Haven were raised on FoNS©. In all three years (1999–2001), insect supplements (mealworms, crickets, and waxworms) were also given, primarily to the aerial insectivore species. Further, fruit supplements were given to species (such as cedar waxwings [*Bombycilla cedorum*]) whose nestling diet includes significant amounts of fruit.

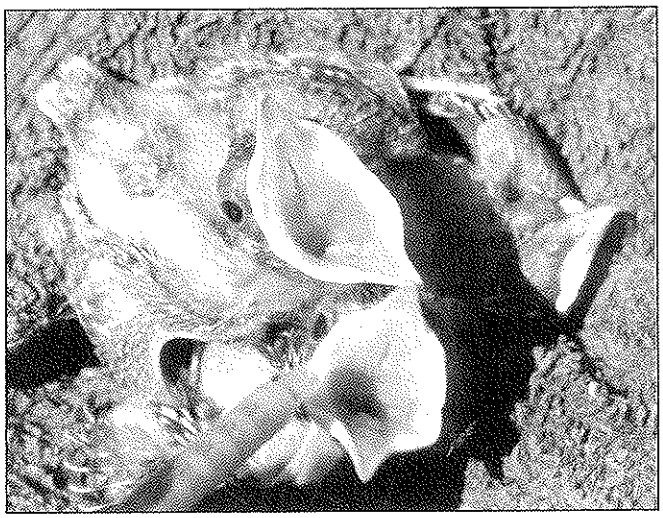
Results

In order to compare the effects of the older formulas with those of FoNS©, all orphans from passerine and other species that would be fed insects as nestlings were identified from our records. Orphaned pigeons, doves, raptors, and all precocial species were excluded from the data set; the more common of the included birds were robins (*Turdus migratorius*), eastern phoebes (*Sayornis phoebe*), chimney swifts (*Chaetura pelagica*), starlings, blue jays (*Cyanocitta cristata*), common grackles (*Quiscalus quiscula*), house sparrows (*Passer domesticus*), cedar waxwings, swallows (including *Tachycinetaa bicolor*, *Hirundo rustica*, and *Hirundo pyrrhonota*), goldfinches (*Carduelis tristis*), and woodpeckers (including *Picoides pubescens* and *Picoides villosus*). Next, all orphans that died within the first 24 hours were eliminated from the pool; any that were injured when admitted but alive after the first day (roughly 5–7% in each year) remained. Finally, the birds in the data set were classified by outcome: released versus died or euthanized. The numbers of birds that fell into each category are given in Table 1 below.

TABLE 1. DISPOSITION OF BIRDS RAISED ON FoNS© vs. LOWER-QUALITY FORMULAS

	Number Released	Number Died/ Euthanized	Total
2001 *(higher-quality diet)*	277	41	318
1999–2000 *(lower-quality diets)*	253	83	336

As can be seen, the overall release rate for birds raised on older-generation formulas in 1999/2000 was about 75%. That for birds raised on FoNS© in 2001 was about 87%. A Chi-squared applied to these figures was highly significant; $X^2 = 14.4$ $p<0.001$.



MARC PAYNE

Syringe-feeding FoNS© to robin nestlings at Avian Haven.

Discussion

Release rate is obviously impacted by factors other than diet alone; however, the high statistical significance of the above results indicates that nutritional quality of nestling food can affect survival, even in a rehabilitation setting where cold temperature, predation, and other risk factors found in the wild do not contribute to mortality.

Unfortunately, some rehabilitators may be unaware of the low quality of the diet in use; many of the traditional formulas circulating in the rehabilitation community do not present macronutrient or other nutritional information, much less any contextual information on the dietary requirements of growing birds. And people who become invested, knowingly or unknowingly, in poor-quality formulas may insist that their diets "work" (even if they don't "look good on paper"). In most cases, though, "working" means only that a majority of the birds survive to release, as there is rarely any way to assess postrelease survival. In the process, these birds eventually *seem* to mature, but there may be no comparison to the growth rates or fledging weights of their wild counterparts. But even without these comparisons, research in the literature of our sister fields—including ornithology, ecology, physiology, and biochemistry—tells us all we need to know: birds raised on diets that do not have high levels of animal-derived protein are disadvantaged if not doomed.

The "revolution" in passerine handrearing diets begun by MacLeod and Perlman is one in which we participate on an ongoing basis; FoNS© is a work in progress. Even more high-quality kitten foods may be available in the future as the result of an increasing recognition of problems that can result from feeding grain and soy sources of protein to mammalian predators. Further, as noted by Klasing (1998), much more research needs to be done on the nutritional needs of species other than poultry; also, there is considerably more to be learned about the protein in insects. As this information becomes available, handrearing diets can be adjusted accordingly as needed. Meanwhile, however, it is not too early to join the revolution—to invest wisely in the fitness and survival of our rehabilitation birds.

FORMULA FOR NESTLING SONGBIRDS® (FoNS®)

120 g (1 cup) Eukanuba® Chicken & Rice Kitten Formula, presoaked in about 1.25 cup water

71 g (1 jar) Beech-Nut Stage 1 Chicken & Chicken Broth® Baby Food

12 g (2 Tb.) dried egg white

5 g (1 tsp.) active-culture plain yogurt or liquid acidophilus

3.0 g pure calcium carbonate

Vitamin mix:
2000–2500 IU vitamin A plus 200–250 IU vitamin D (e.g., 5 drops cod liver oil)

15–20 IU vitamin E
(e.g., 1 drop from a 100-IU soft-gel)

20–25 mg range vitamin B complex
(e.g., half of a "B-50" capsule)

50–75 mg vitamin C
(e.g., fraction of a vitamin C capsule)

Blend in food processor until smooth. Water amounts may be varied to achieve desired consistency for feeding. Soaking time is reduced if kitten kibble is pulverized in food processor prior to adding water. *See notes below for important information about ingredients.*

Dry Weight Composition: 46% protein, 22% fat, 23% carbohydrate

Calcium:Phosphorous ratio: 2:1

Energy: 1.3 kc/cc

Supplementing with live insects is recommended.

FoNS © 2002 Diane Winn, Avian Haven

Ingredient Information

Note: Except for the substitutions described below, changing any of the ingredients will change the formula macronutrient levels and calcium:phosphorous ratio.

Eukanuba® Chicken & Rice Kitten Formula: All brands of kitten food are not alike; in attempting to estimate the proportion of animal:plant protein sources, remember that ingredients are listed in the order of their prevalence. The *first three* ingredients in Eukanuba® are animal products; many other brands have a grain as the *second* ingredient. Even higher-priced specialty kitten foods may have fewer animal ingredients. Plant sources of protein do not appear to be highly bioavailable to insectivores; products that contain soy or gluten are not desirable.

Beech-Nut Chicken & Chicken Broth® Baby Food: All brands of chicken baby food are not alike, either. For example, Gerber Chicken & Chicken Gravy® contains cornstarch and has about twice as much fat as the Beechnut. For people who have trouble locating this product, 35 g of low-salt canned chicken contains about the same amount of protein as in the baby food and may be substituted; however, the resultant consistency will not be as smooth. [Note: The information about "strained chicken" baby food currently in the USDA database appears to be incorrect; anyone who wishes to examine the contents of these products closely should rely on fact sheets provided by the manufacturers.]

Dried Egg White: Dried egg white is available in supermarkets and health food stores; however, it is cheaper when purchased in larger quantities. Avian Haven buys in bulk from The Egg Store (1/888/677-3447) or online at www.eggstore.com. Three *large* hard-boiled egg whites contain the same amount of protein as in 12 g (2 Tb.) of dried egg white and may be substituted if necessary. However, the consistency of the formula will not be as smooth.

Yogurt/Acidophilus: These products provide beneficial gut bacteria that may not survive freezing, so add them after any frozen formula has been thawed. According to microbiologists (various pers. comm.): (a) Different strains of bacteria colonize different avian species; no single product would contain appropriate bacteria for *all* birds. (b) Lactobacillus may or may not normally colonize an avian digestive tract, but will compete with harmful bacteria while bird's natural strains develop. (c) Dried lactobacillus (or other gut-bacteria) products may not contain a high proportion of live bacteria.

Calcium Carbonate: Calcium must be added in order to bring the calcium:phosphorous ratio of the formula to the 2:1 recommended for growing bones; the amount in FoNS® was calculated on the basis of the amounts of calcium and phosphorous delivered by the other ingredients. Relative to other sources of calcium, calcium carbonate is considered to be highly bioavail-able to birds (see, e.g., Klasing 1998); pure calcium carbonate is 40% elemental calcium. It is typically sold in powder form (e.g., NOW® brand calcium carbonate powder can be ordered through health food stores). Unfortunately, because of variations in the density in the powder, a given weight of calcium carbonate will not always be the same measured volume. Use a gram scale (preferably accurate to 0.1 g) to weigh the amount that is added to this formula. If such a scale is not available, calcium tablets may be substituted, but do *not* use a product that contains other minerals or ingredients such as talc, cornstarch, or sugar. 1000 mg of *elemental* calcium (a daily amount often recommended for adult humans) will bring FoNS® to a Ca:Phos ratio of 1.9:1. For more information about the use of calcium carbonate, see Perlman and MacLeod (2001).

Vitamins: The vitamin amounts suggested in the ingredients box are based on a consideration of the quantities already present in the main ingredients; they also take into account Klasing's (1998) discussion of the minimum amounts required for growing birds, the stability of various vitamins over time, and their dosage margin of safety. Commercially available avian multiple-vitamin products vary in their components, which may or may not meet the recommendations for avian growth. For people who wish, nevertheless, to use such a product, I suggest calculating and adding an amount based on its vitamin A component: for example, about 2000 IU of vitamin A is contained in 1 g (about 3/8 tsp.) of SuperPreen® and in 2 g (about 1/2 tsp.) of AviEra®. Based on discussions in Klasing (1998), the minerals present in the main ingredients of FoNS® should be sufficient to meet the needs of growing birds.

APPENDIX. THE AVERAGE AMOUNT OF PROTEIN IN INSECTS

The amount of protein in a food is typically estimated from its total nitrogen content (see, e.g., Berdanier 2000). The standard procedure is to multiply nitrogen % by 6.25, a factor representing the amount of nitrogen in most proteins. This process assumes that nitrogen is present only as protein, an assumption not valid in insects because their chitin (the main component of the arthropod exoskeleton) contains nitrogen (Redford and Dorea 1984).

Most of the studies that provide nutritional analyses for multiple insect species acknowledge but do not address this problem; an exception is the Barker, Fitzpatrick, and Dierenfeld (1998) paper cited in the main text. These researchers *did* measure chitin-bound nitrogen in their samples of (mostly) captive invertebrates, subtracting it from total nitrogen before deriving protein %. Chitin levels, like nitrogen levels, vary widely among insects; however, where this information is unavailable, Bell (1990) suggested reducing the nitrogen content of insects by 8.5%, a factor he judged to represent the amount of nitrogen bound to chitin in the "average" insect.

Several papers reported nitrogen %s for a variety of noncaptive invertebrate orders: Ramos-Elorduy et al. 1997; Redford and Dorea 1984; Robel et al. 1995. In working from information in these articles toward an overall average % protein, nitrogen %s for each species were adjusted using Bell's (1990) factor, then converted to protein %. Next, within each study, estimated protein %s were averaged for species within orders; finally, estimated protein %s were averaged across orders. Table 2 summarizes this information.

The protein %s presented below must be viewed with caution, for several reasons. First, methods for measuring nitrogen (from which protein estimates are derived) are not always consistent across studies. A fifth study, Studier and Sevick (1992), used a different method than that of the researchers in Table 2; their nitrogen %s were nearly double than those typically reported in other studies (even with the adjustment suggested by Bell, protein levels derived from their nitrogen %s were, for some orders, in excess of 100%).

A related issue to keep in mind is whether Bell's (1990) chitin adjustment factor is appropriate for all insects, even on an average basis (for example, research described in deFoliart 1975 suggests that a factor approximately three times as large as Bell's may be appropriate for some locust species). Perhaps a better adjustment for nonprotein nitrogen would bring results of the Studier and Sevick (1992) study into the ranges reported by other researchers. This study included 16 orders of insects collected in Michigan, so it is unfortunate that meaningful protein %s cannot be derived from its data.

Finally, the samples of insects in the data set below may not represent the population of insects available and desirable to the "average" breeding bird in North America; also, not all of the insects in this data set were collected in North America. The insects studied by Ramus-Elorduy et al. were species deemed "edible" by people of Mexico; nevertheless, these data are worth considering because they appear to include more immature forms than would typically be collected by sweepnet (as in, e.g., Robel et al.). The insect orders that were sampled by studies in the data set of Table 2 include the following (the accompanying estimated protein %s were averaged across studies): *Orthoptera* (grasshoppers, crickets) 59%; *Diptera* (flies) 50%; *Hymenoptera* (ants, wasps, bees) 50%; *Hemiptera* + *Homoptera* (plant bugs) 49%; *Lepidoptera* (moths, butterflies) 48%; *Coleoptera* (beetles) 47%; *Isoptera* (termites) 40%.

Clearly, more research needs to be done on ways to sample insect populations and to accurately estimate their protein levels. Meanwhile, however, a *very* rough estimate of the average protein % of insects (as extrapolated from results of the above-cited articles and adjusted as suggested by Bell 1990) would be about 50%. It should be stressed that Barker, Fitzpatrick, and Dierenfeld (1998) were the only researchers among those cited above to use empirical measures of chitin-bound nitrogen in deriving protein %; thus, although their protein estimates are limited in scope, they are high in validity.

TABLE 2. ESTIMATED PROTEIN % OF INSECTS

Authors	Collection Location	No. of Insect Orders	Estimated Protein % (DM basis)	
			Range of Order Means	Grand Mean of Order Means
Barker et al.	(captive)	5	31–60	46
Ramos-Elorduy et al.	Mexico	7	31–61	44
Redford & Dorea	mostly U.S.	6	40–65	54
Robel et al.	Kansas	12	50–67	58

Acknowledgements

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NEO-REHABILISMS...

koikilotherms
animals dependent on carp as a source of heat

refurgitate
the action of a cat with a hairball

Survival and Movements of Translocated Raccoons in Northcentral Illinois

by Maia Mosillo, Edward J. Heske, and John D. Thompson

Many species of wildlife are thriving in human-dominated landscapes. In the midwestern United States, for example, some species of game and furbearing mammals such as white-tailed deer (*Odocoileus virginianus*), coyotes (*Canis latrans*), raccoons (*Procyon lotor*), and opossums (*Didelphis virginiana*) are probably near historical record high numbers (Hoffmeister 1989). As populations of humans also continue to increase, conflicts between humans and wildlife are inevitable. In 1994, for example, 45,331 mammals were handled by nuisance wildlife control permittees in Illinois (Bluett 1995). Raccoons accounted for 13,193 (29%) of these mammals and were by far the most common pest species. Illinois law allows for nuisance raccoons to be euthanized, but many are relocated to woodlots or forest preserves in rural areas. A total of 18,879 mammals were reported as translocated and released in Illinois in 1994, including 5,832 raccoons (Bluett 1995). These numbers are typical of recent years, but they probably underestimate the true numbers of translocated animals because many residents of rural areas handle nuisance wildlife problems without reporting them to state agencies.

Translocating nuisance wildlife to rural habitats might seem a humane way to handle problem animals. However, survival rates of translocated animals after release are not known. Translocated deer, for example, generally have high mortality rates (O'Bryan and McCullough 1985, Jones and Witham 1990, Bryant and Ishmael 1991). Radiotelemetry studies of translocated raccoons have yielded mixed results. Frampton and Webb (1973) and Taylor and Pelton (1979) reported high survival rates among translocated raccoons, but Wright (1977) and Rosatte and MacInnes (1989) found more than half of the raccoons translocated in their studies died within a few months of release. Few studies have monitored the fates of raccoons translocated from urban to rural environments (Rosatte and MacInnes 1989), and no published studies have simultaneously monitored survival rates of resident raccoons at the release site.

Translocating wildlife could facilitate the spread of zoonotic diseases (Davidson and Nettles 1992). For example, the rapid spread of rabies in raccoons in the eastern United States has been linked to translocation of disease-carrying animals (Nettles et al. 1979, Smith et al. 1984, Jenkins and Winkler 1987). If translocated raccoons settle near human residences, they could add to nuisance wildlife problems in rural areas. Finally, translocated raccoons could compete with resident populations for food or other resources, disrupt existing social structure of resident populations, or increase rates of predation on songbird and waterfowl nests or other threatened wildlife.

This study compares survival rates, dispersal from release area, and causes of mortality among raccoons translocated from an urban to a rural area, translocated from a rural to a rural area, and (as a control) residents captured at the rural release site. The authors recorded habitats used as daily den sites by translocated and resident raccoons as an indicator of whether translocated raccoons were likely to add to wildlife nuisance problems for human residents of rural areas.

Study Area

The study was conducted in southern Kane County and northern Kendall County, Illinois. The release site was the Lone Grove Forest Preserve (LGFP) in Kane County (80°33'45"E, 41°51'3"N). The 47.3 ha preserve included about 33.3 ha of mature upland forest in two blocks on either side of a paved road, 2 ha of old field undergoing succession, and 12 ha of open, mesic grassland bisected by a small creek.

The area surrounding LGFP was dominated by row-crop agriculture, primarily corn and soybeans. Agricultural fields were occasionally dissected by creeks or drainage ditches. A few isolated woodlots were scattered throughout the region. Most

ABSTRACT: The authors monitored postrelease survival rates and dispersal of radiocollared raccoons (*Procyon lotor*) that were trapped as nuisance wildlife in suburban Chicago and translocated to a rural forest preserve (translocated urban); trapped in another wooded area and translocated to the forest preserve (translocated rural); and trapped and released in the forest preserve that served as the release site for the translocations (resident). The authors detected no difference in survival rates among the three treatment groups ($P<0.05$), although their proximity to the release site and their denning locations differed. Because translocated raccoons survived well, translocation could be an effective way to supplement depleted or re-establish extirpated populations of this species. However, translocating large numbers of raccoons for aimal damage control could cause problems for other wildlife and humans near release sites, and translocated animals could serve as vectors for wildlife diseases during zoonotic outbreaks.

KEY WORDS: animal damage control, nuisance wildlife, raccoon, *Procyon lotor*, survival rates, translocation

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woodlots were small (<10 ha) and appeared as islands in the agricultural matrix. The only other trees in this landscape were associated with farmsteads, residential areas, and occasionally along creeks.

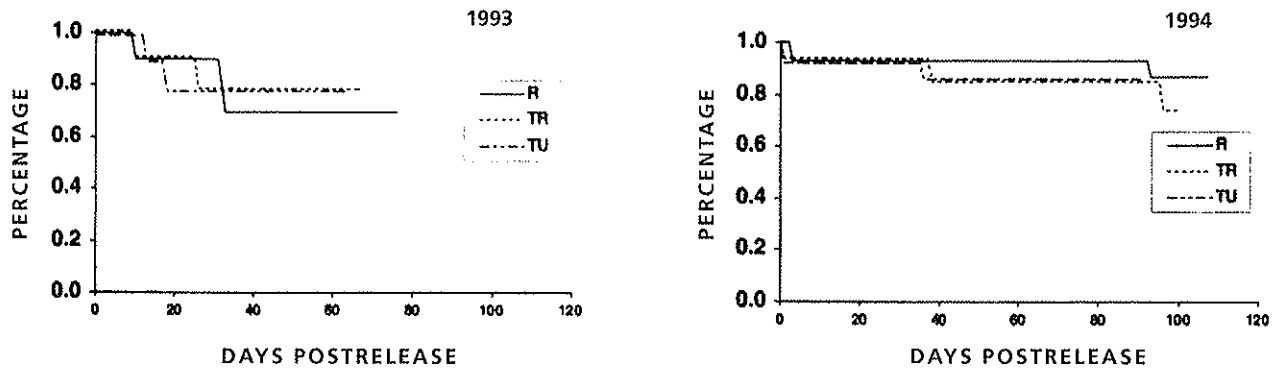
Methods

The authors studied three treatment groups in each year: resident raccoons were live-trapped in LGFP; translocated rural raccoons were live-trapped in another wooded area (Max McGraw Wildlife Foundation, Dundee, Illinois); and translocated urban raccoons were captured by licensed animal control agents in response to nuisance wildlife complaints (from Kane, DuPage, and Cook Counties, Illinois). In 1993 the authors captured and radiocollared resident raccoons from 30 August–1 October, translocated rural raccoons from 2–29 September, and translocated urban raccoons from 6–29 September. In 1994 the authors captured and radiocollared resident raccoons from 28 July–1 August, translocated rural raccoons from 3–11 August, and translocated urban raccoons from 14 August–23 September. Raccoon movements from 1 September–15 November 1993, and 28 July–12 November 1994 were followed. The authors conducted their study in the fall of each year because this is when the greatest number of nuisance raccoon complaints occur.

The authors captured raccoons in box traps, sedated them with Telazol®, then weighed, measured, and eartagged them for individual identification. Approximately equal numbers of adult males and females in each treatment group were fitted with radiocollars. Radiocollars were equipped with a mortality switch and weighed 120–126 g. Animals were held in their traps until they recovered from the anaesthetic and were then released at LGFP. All translocated animals were released at the parking area on the north side of LGFP because this was the standard practice of many nuisance animal control agents. Resident raccoons were released either at their capture site or at the parking area if the capture site was less than approximately 5000 m away, and they were released within 24 hr of capture. The Laboratory Animal Care Advisory Committee of the University of Illinois at Urbana-Champaign approved all procedures for capture and handling of raccoons.

After release, the authors attempted to locate radiocollared raccoons daily until mid-November. Data collection for an acclimation period was not delayed because some responses of interest (e.g., dispersal from the release site) typically occurred in the first few days after release. Azimuths were recorded via a vehicle-mounted, single-peak yagi antenna system. Four (4) azimuths/raccoon were recorded for each daily location from a set of fixed points corresponding to landscape features easily identifiable on maps and aerial photographs. Because the study area was generally covered with a grid system of county roads at 1.6 km (1 mile) intervals, the authors were able to confirm the locations by driving around the area until the particular landscape feature where the animal had denned was identified. Daily locations of radiocollared raccoons were then plotted on aerial photos. The authors determined linear distance from the release point and determined habitat classification for each location: woodlot, hedgerow, waterway, agricultural field, residential property (farmsteads and other human habitations). Habitat use at this scale was easily determined in the field when azimuths were recorded, given the open landscape and grid-like system of rural roads. Because only some individuals, particularly resident raccoons, were located consistently, the authors quantified habitat use as frequency distributions for comparative purposes. A frequency distribution of den sites in each habitat was first calculated for each individual. Frequencies in each habitat type were then summed over all individuals in each treatment group for each year, and overall frequency distributions were recalculated from these summed values. Thus, each individual contributed equally to the final frequency distribution for each treatment group in each year.

FIGURE 1. KAPLAN-MEIER SURVIVAL FUNCTIONS



Kaplan-Meier survival functions, estimated from days postrelease, for radiocollared raccoons trapped and released at the Lone Grove Forest Preserve, Kane County, Illinois (resident = R), trapped in another wooded area and translocated to the forest preserve (translocated rural = TR), and trapped as nuisance wildlife in suburban Chicago and translocated to the forest preserve (translocated urban = U). Daily tracking was conducted 30 August–15 November 1993 and 28 July–12 November 1994. Curves are of different lengths because some groups were tracked for longer intervals than others.

TABLE 1. FATES OF RADIOCOLLARED RACCOONS

	1993			1994		
Treatment Group	Survived	Died	Disappeared[a]	Survived	Died	Disappeared[a]
Daily tracking period[b]						
Resident	7	3		13	2	
Translocated rural	7	2	2	8	3	4
Translocated urban	5	2	3	12	2	1
Overwinter[c]						
Resident	5	1	1	11	2	
Translocated rural	5	1	1	4	2	2
Translocated urban	4	1		8	1	3

[a] Individuals could no longer be located, no mortality signal detected.
[b] 1993: 30 August–15 November; 1994: 28 July–12 November.
[c] November–April.

Fates of radiocollared raccoons trapped and released at the Lone Grove Forest Preserve, Kane County, Illinois (resident), trapped in another wooded area and translocated to the forest preserve (translocated rural), and trapped as nuisance wildlife in suburban Chicago and translocated to the forest preserve (translocated urban), 1993–94.

Results

The study radiocollared and tracked 76 raccoons: 31 (15 M, 16 F) in 1993 and 45 (23 M, 22 F) in 1994. Sample size in each treatment group was equal within each year, with the exception that the authors radiocollared 11 raccoons in the translocated rural group in 1993 (instead of 10). Radiocollared animals were monitored for 45–77 days in 1993 and 50–107 days in 1994.

Survival functions did not differ between males and females in either year (1993: $X^2 1 = 0.75$, $P = 0.39$; 1994: $X^2 1 = 1.38$, $P = 0.24$); therefore, the authors pooled sexes for further analysis. Each year was analyzed separately because raccoons were tracked for >1 month longer in 1994 than in 1993.

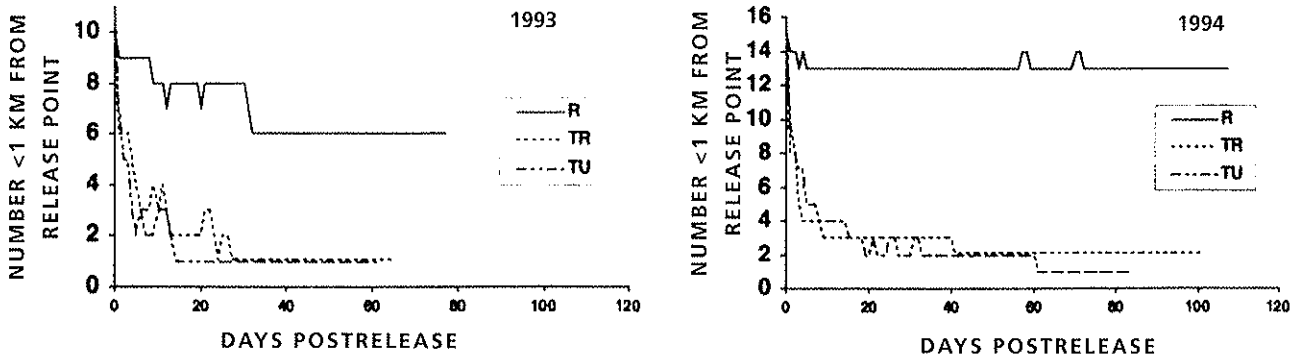
Survival functions did not differ among the three treatment groups (1993: $X^2 2 = 0.18$, $P = 0.91$; 1994: $X^2 2 = 0.66$, $P = 0.72$; Figure 1). The authors also did not detect differences in survival estimates among treatment groups in either year (mean estimate at 45 days postrelease for 1993: resident = 0.70 [95% CI = 0.27], translocated rural = 0.79 [95% CI = 0.27), translocated urban = 0.78 [95% CI = 0.31]; mean estimate at 50 days postrelease for 1994; resident = 0.93 [95%CI = 0.12], translocated rural = 0.85 [95% CI = 0.20], translocated urban = 0.87 [95% CI = 0.18]). Fourteen known deaths occurred during the daily radiotracking periods in 1993 and 1994: five raccoons were killed by vehicles, four were apparently killed by local homeowners (three radiocollars were found discarded, one raccoon was found shot), one raccoon was trapped and killed as nuisance wildlife on private property, and four died of unknown causes (death occurred in tree cavities or in ground burrows, hence carcasses were not recovered for necropsy). Mortalities were distributed similarly among all three treatment groups (Table 1). In addition, 10 radiocollared animals were lost during the daily tracking period, and their fates were unknown.

Of 19 radiocollared raccoons known alive at the end of the tracking period in 1993, 14 survived the winter, three died between November and April, and two disappeared (fates unknown). Of 33 radiocollared raccoons known alive at the end of the tracking period in 1994, 23 survived the winter, five died between November and April, and five disappeared (Table 1). Pooling data from both years, the numbers of raccoons that survived the winter, died during the winter, or were lost during the winter were not different among treatment groups ($X^2 4 = 3.86$, $P = 0.43$). Excluding lost animals from the analysis did not affect the results ($X^2 2 = 2.17$, $P = 0.34$).

Resident raccoons denned in or near LGFP during the radiotracking periods in both years, with the exception of one male in 1993 and one female in 1994 (the latter wandered widely but returned periodically until killed on the road about 1 month postrelease). In contrast, almost all translocated raccoons dispersed from the release site (Figure 2). In 1993 only two of 21 translocated raccoons were still denning <1 km from the release site at the end of the tracking period. Pooling data from both years and excluding animals that died or were lost, 18 of 20 resident raccoons, three of 16 translocated rural raccoons, and three of 17 translocated urban raccoons were still denning <1 km from the release site at 50 days postrelease ($X^2 2 = 25.93$, $P<0.001$). Differences in residency among the treatment groups were underestimated by this analysis because four of the raccoons in the resident sample that died before 50 days postrelease had consistently denned in the LGFP during the period they were monitored prior to their deaths.

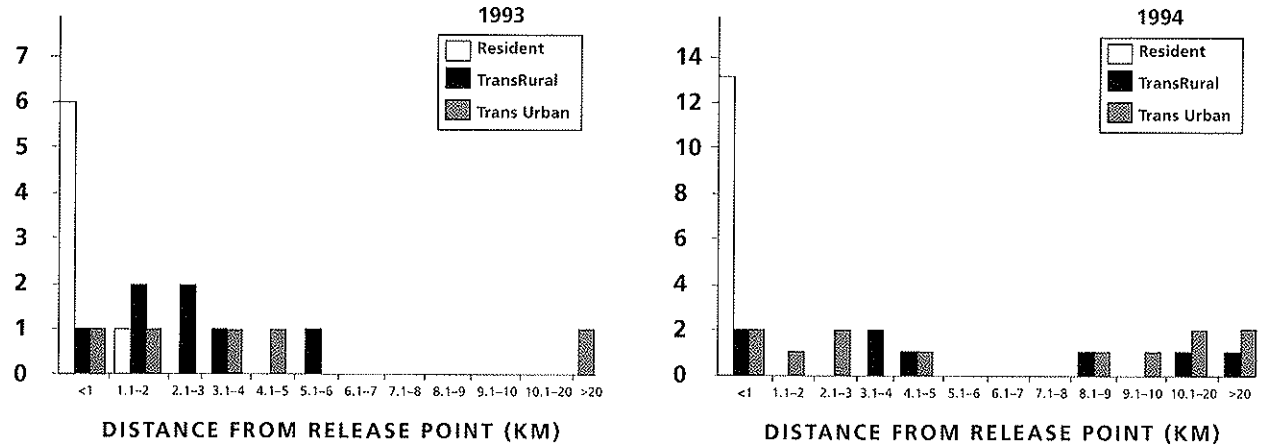
Whereas most of the resident raccoons remained near the release site, many of the translocated rural and translocated urban raccoons dispersed considerable distances (Figure 3). Three translocated raccoons were located 24, 25, and 60 km from the release site during aerial searches. The mean distance

FIGURE 2. DEN DISTANCES FROM RELEASE SITE OVER TIME



Numbers of radiocollared raccoons trapped and released at the Lone Grove Forest Preserve, Kane County, Illinois (resident = R), trapped in another wooded area and translocated to the forest preserve (translocated rural = TR), and trapped as nuisance wildlife in suburban Chicago and translocated to the forest preserve (translocated urban = TU) that denned < 1 km from the release site over time (days postrelease), 1993–94. Declines include losses due to both dispersal and mortality. Curves are of different lengths because some groups were tracked longer than others.

FIGURE 3. FREQUENCY DISTRIBUTION OF DEN SITE HABITATS



Distances from the release site for radiocollared raccoons trapped and released at the Long Grove Forest Preserve, Kane County, Illinois (resident = R), trapped in another wooded area and translocated to the forest preserve (translocated rural = TR), and trapped as nuisance wildlife in suburban Chicago and translocated to the forest preserve (translocated urban = TU) and known alive at the end of the period of daily radiotracking, 1993–94.

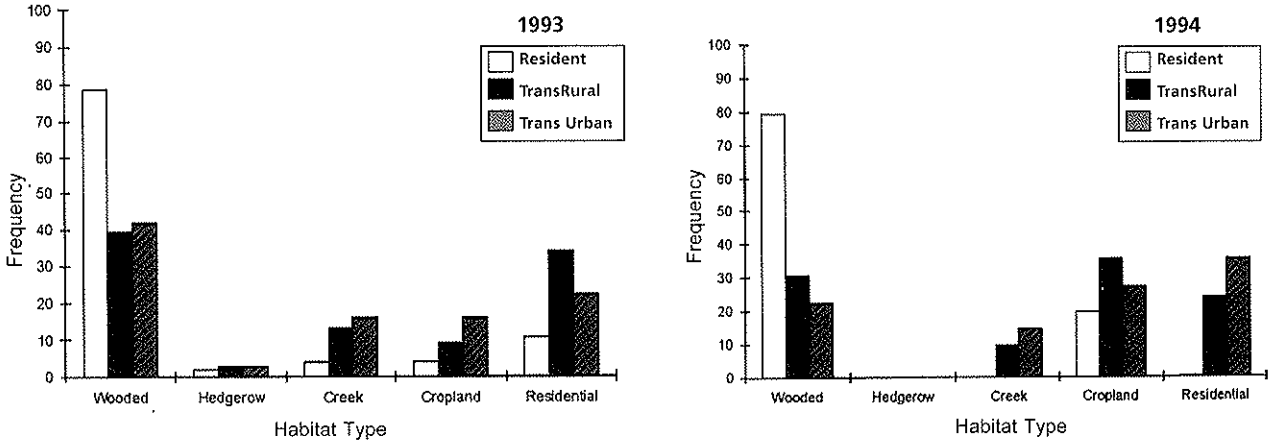
from the release site, excluding known mortalities, at the end of the period of daily tracking each year differed among treatment groups (1993: $X^2 = 7.78$, $P = 0.02$; 1994: $X^2 = 18.95$, $P < 0.001$). In both years, distances from the release site for resident raccoons (1993: 731 ± 424 m; 1994: 391 ± 125 m) were less than those for both translocated rural (1993: 3796 ± 2852 m; 1994: 9092 ± 8013 m) and translocated urban raccoons (1993: 7218 ± 8055 m; 1994: 7870 ± 6962 m; $Ps < 0.05$), whereas translocated groups did not differ in either year ($Ps > 0.05$).

Resident raccoons denned most frequently in wooded areas (i.e., LGFP; Figure 4). Translocated raccoons frequently denned near human residences as well as in wooded areas, and they often denned in agricultural fields and along waterways.

Discussion

In both years of the study, about 75–80% of the translocated raccoons survived until ≥ 2 months postrelease (Figure 1), which did not differ from survival estimates for raccoons trapped at the release site. The survival of a translocated individual probably depends on a variety of factors, including condition and

FIGURE 4. HABITAT TYPE



Frequency distributions of habitats used for den sites during 1993–94 by radiocollared raccoons trapped and released at the Long Grove Forest Preserve, Kane County, Illinois (resident = R), trapped in another wooded area and translocated to the forest preserve (translocated rural = TR), and trapped as nuisance wildlife in suburban Chicago and translocated to the forest preserve (translocated urban = TU), weighted so that each individual raccoon contributes equally. "Wooded" = woodlot or forest preserve; "Hedgerow" = hedgerow or treeline; "Creek" = creek or drainage ditch; "Cropland" = agricultural field; "Residential" = farmstead, house, or other human construction.

however, among the three treatment groups. Severe winter weather did not begin until about 3 months after translocations were conducted, and translocated raccoons still being monitored at the end of the fall radiotracking period had typically established new home ranges and den sites by that time.

In contrast to survival rates, dispersal patterns differed considerably between resident and translocated raccoons. Most of the resident sample remained in the vicinity of LGFP; with few exceptions, the linear distance between successive den sites averaged <400 m. Both translocated rural and translocated urban raccoons typically dispersed from the release site within hours to a few days. Dispersal could be a consequence of competition for den sites or other resources with resident animals at the release site, or due to disorientation and attempted homing by the released animals. The probability that a translocated raccoon would remain at the release site and the total distance dispersed from the release site by the end of the tracking period did not differ between raccoons translocated from urban to rural or from rural to rural environments.

The 24 translocated urban raccoons tracked by Rosatte and MacInnes (1989) similarly dispersed from their rural release sites but generally settled within 10–20 km of the release site. Other studies have reported some long-range movements by translocated raccoons; Wright (1977) reported mean dispersal distances of 27.5 km for 28 radiocollared and 25.7 km for 13 recovered (of 1,750 eartagged) raccoons moved from Florida to Kentucky, and Tabatabai and Kennedy (1989) reported a mean dispersal distance of 32.4 km for 25 recovered (of 450 eartagged) raccoons moved from urban to rural areas in Tennessee. The latter two studies detected maximum dispersal distances of 107 km and 295 km, respectively, from release sites for recovered, eartagged animals.

Because most of the translocated raccoons did not stay at the release site and sometimes dispersed considerable distances, translocated animals could add to nuisance wildlife problems for rural human residents or increase the spread of disease during zoonotic outbreaks. Raccoons exhibit high incidences of exposure to various wildlife diseases (e.g., Krebs et al. 1995, Centers for Disease Control 1997), and the risk of translocating diseases or parasites along with nuisance animals is an important consideration (Cunningham 1996). Hence, because some translocated animals disperse for long distances after translocation, the rate of spread of zoonotic disease could be accelerated considerably. Indeed, many translocated raccoons denned near human residences or on residential property, including backyards, barns, houses, and even a gas station. At least four translocated raccoons were captured or killed by local human residents because of nuisance behavior (one during the tracking period, three during the winter of 1994).

Further research on the effects of translocating raccoons is warranted because of the potential consequences for other wildlife species. Raccoons are important nest predators on songbirds (Whelan et al. 1994, Donovan et al. 1997), game birds (Miller and Leopold 1992), waterfowl (Urban 1970, Duebbert and Kantrud 1974, Greenwood 1981, Jobin and Picman 1997), and other wildlife (e.g., turtles; Christens and Bider 1987, Congdon et al. 1987). Translocated raccoons also may compound the intense predation pressure already experienced by some wildlife in fragmented habitats. In some areas, existing management practices, such as waterfowl management (Urban 1970, Fritzell 1978, Sargeant et al. 1993) near a release site, could be jeopardized by an infusion of translocated raccoons. Finally, increased competition for food and den sites, or disruption of social organization, could negatively affect resident raccoons.

Management Implications

This study shows that survival rates of translocated raccoons can be as high as those of resident animals. This finding supports the view of some that translocation is a humane method for handling nuisance wildlife problems (Diehl 1988). However, large numbers of raccoons translocated into an area could increase competition for resources with resident raccoons, predation pressure on the other wildlife, and nuisance wildlife problems for human residents near release sites. Records from licensed animal controllers in Kane County show that ±84 raccoons were released in LGFP in 1993 prior to this study, and 823 more were released at other sites within the county. Raccoons are abundant in most of the United States Midwest, and there are few, if any, places to release a translocated raccoon where there is not already a substantial population of other raccoons or people. Further, most nature preserves around urban or sub-urban areas are relatively small and are unlikely to accommodate the thousands of animals handled by animal control professionals each year. Even when a translocated raccoon survives, however, this study indicates it rarely stays at the release site. When the risk of facilitating the spread of disease during zoonotic outbreaks also is considered, translocation of nuisance wildlife becomes a less attractive option.

Alternatives to translocation for solving nuisance wildlife problems also have drawbacks. The simplest alternative is euthanasia, but it is the most controversial. The use of reproductive inhibitors (Howard 1967) or surgical sterilization (Bojrab et al. 1983) is costly and labor intensive. Physically excluding nuisance wildlife from private property would be the most humane solution but may be difficult and ineffective. Thus, the negative effects of translocating large numbers of animals on wildlife and human residents of rural areas near release sites must be weighted against the negative public opinion and ethical considerations concerning euthanasia or sterilization when determining policy for the disposition of nuisance wildlife.

Acknowledgments

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Products Cited

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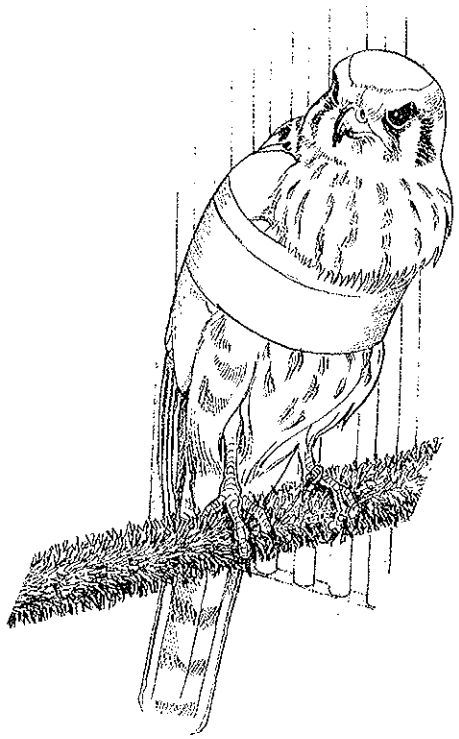
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COLUMN

Operating Instructions

NUISANCE SITUATIONS INVOLVING PIGEONS

by Nathalie Karvonen

In all "nuisance wildlife" situations, it is important to explain to people why animals behave the way they do. This helps create some empathy for the critter(s) involved.

A lot of city dwellers call our hotline with questions and complaints about pigeons (or rock doves). In the wild, pigeons used to roost and nest on cliffs and rocky ledges. Today, in urban areas, they seek out similar structures—usually high, flat surfaces such as the tops of signs, rooftops, window sills, or balconies.

The simplest way to deter pigeons from roosting on the the ledge or railing of a balcony is to add a physical barrier that prevents the birds from coming in contact with the roosting area. A stiff piece of wire strung from one end of the railing (or ledge) to the other at least a couple of inches above the area will prevent the birds from accessing it. The pigeons will not be comfortable roosting on a skinny piece of wire and will go elsewhere. Make sure that the caller knows not to use something flexible such as fishing line in case it comes loose and gets wrapped around a bird's legs, feet, or wings.

In order to roost on sloped roofs, pigeons generally come in for a landing at the peak of the roof and walk down to another area. As above, stringing a piece of wire a couple of inches above the peak, from one end to the other, should discourage them from landing on the peak in order to access the rest of the roof.

A balcony that is "furnished" with a barbecue grill, lawn chairs, or boxes provides shelter from the elements and hiding places from predators, making it an ideal nesting spot. It is especially appealing if it is not used much, as is usually the case during the winter.

Pigeon nests are usually pretty flimsy—just a few sticks pushed together and hidden behind a box or under a chair. Pigeons can nest all year round and usually lay two eggs. If the eggs have been in the nest for an unknown period of time, or if there are babies in the nest, we strongly encourage tolerance until the young are hatched and old enough to fly away. Callers should be informed that the eggs will hatch in 17 to 19 days, and that the young should be flying in approximately 35 days.

The caller can do some quick cleaning of the balcony—or even use the barbecue—during the waiting period, if they wish. But they should keep their time on the balcony to just a few minutes, especially if there are eggs in the nest or very young babies. In these situations, the young need one of the parents with them most of the time to keep them warm. *Under no circumstances should the caller let their pets out onto the balcony.*

If the caller wants to do some quick cleaning, ensure that they do not remove the protective object(s) that the pigeons chose to hide their nest under/behind. Also, the caller should wear a face mask and rubber gloves when cleaning bird feces from the balcony.

The caller should keep a close eye out during the waiting period to make sure that other doves do not make an additional nest on the balcony (or the same doves if the first babies are older). If this does happen, and the caller catches it quickly, the nest and eggs should be removed immediately. In most areas, a permit is not required to do this.

Once the baby doves are old enough to fly, the balcony should be completely cleaned (using the above precautions) and all objects that could provide cover for other nests removed.

Don't Feed the Pigeons!

Many people who enjoy feeding birds in their yards do not appreciate the presence of pigeons, who quickly learn where they can get a free meal. Luckily, this situation is easily remedied. Feeders can be stocked with small seeds, which pigeons do not enjoy as much as the larger ones. Callers can also purchase a feeder with weight-sensitive perches; heavier critters (including pigeons and squirrels) will trigger the door of the feeder to close, denying them access to the seed inside.

Pigeons are intelligent birds. A big, "scarey" **plastic owl** placed on a roof or a balcony to deter them from coming to visit, is unlikely to work for long. At first the birds may be wary of their new guest. But, after it does not move for a day or so, the pigeons will quickly habituate to it and not consider it to be any threat to them at all. Some claim that hanging the owl from a string so that it moves with the wind makes it more effective, however, we have not found this to be true—at least not for long.

Always talk to callers about pigeon poisoning (with **Avitrol**), which is a nasty practice carried out by some pest control companies (unless you are lucky enough to be in an area which has outlawed it). In my opinion, poisoning pigeons is cruel and pointless. The birds die a slow and painful death, convulsing and shaking. Nontarget birds are often poisoned unintentionally, including secondary poisoning of wild animals (like the peregrine falcon) that prey on pigeons. The nuisance situation that prompted the desire to use the poison, unless long-term measures are implemented, will likely keep happening. There is no shortage of pigeons in most urban areas and, if the attractant remains, the birds will keep coming.

Pigeons and People: A Long History

The pigeon was the first bird to be domesticated by our species in about 4500 BC. Over the centuries, we have used pigeons for meat and trained them to help us find shipwrecked sailors. They have carried messages for us in wartime; news of Napoleon's defeat at Waterloo reached England by carrier pigeon four days before the news reached there by horse and ship.

By talking to our callers about pigeons and their long-standing relationship with us and giving them easy solutions to their problems, we can help people to tolerate the unwitting indiscretions of this bird and co-exist with them in peace. 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

MICROMINERALS

by Astrid MacLeod and Janine Perlman

Although there is no universal definition for microminerals, they are generally agreed to include minerals needed (and present in the body) in amounts equal to or less than those of iron. Nine trace minerals and six ultratrace elements are believed to be essential.

As noted in the last "Food for Thought" column, minerals are quite different from vitamins. They are inorganic and chemically stable, so they do not break down in storage. They don't break down in the body, either, but small amounts are lost daily through normal body processes such as cell replacement and sloughing (e.g., from the gut and skin).

Many of the microminerals are metals. Because some are chemically similar, essential (and nonessential) minerals can compete with each other for absorption and use in the body. For this reason, an excess of one mineral can cause a deficiency of another. Other inhibitors of mineral absorption may include substances from plants such as fibers, tannins, oxalate, and phytate. On the other hand, many microminerals are better absorbed when consumed from animal sources and/or in association with organic molecules (e.g., heme, or amino or other organic acids). Absorption of minerals is often responsive to their levels in the body; minerals are better absorbed when body levels are low, and less efficiently absorbed when the animal is replete in the mineral.

Iron is well known for its role in hemoglobin, the protein in red blood cells that carries oxygen. There, iron resides in the center of a heme group, a ring-like structure. Iron is also needed by pathogens for their own cellular metabolism. In a bacterial or parasitic infection, mammals and birds sequester iron in areas away from their circulation so as to starve the pathogens. This causes "anemia of infection," which, if aggressively treated, as by high iron supplementation or intravenous iron dextran, can result in the pathogens overwhelming the host's immune system. Myoglobin, the oxygen carrier in muscle, likewise contains iron in a heme group of the protein.

Iron is a cofactor in a large number of enzymes involved in a wide range of metabolic functions, including the harvesting of energy from food, DNA synthesis, amino acid metabolism, the antibacterial immune response, the formation of collagen, and more. Deficiency symptoms include loss of stamina (from anemia) and, in some cases, loss of coat or feather pigmentation.

Dietary sources include organs, red meat, clams and oysters, nuts, and green leafy vegetables. Iron is better absorbed in heme than in other forms; absorption is also aided when it is chemically reduced by antioxidants such as ascorbic acid.

Iron absorption is fairly well regulated depending on need, but oversupplementation can result in toxicity. Captive mammals and birds are subject to potentially lethal "iron storage disease," which may be a combination of excess dietary iron, stress, and other as-yet-unknown factors.

Copper is required for the transport of iron; thus, a deficiency of copper also results in anemia. Copper, like iron, is required in the oxidation of food for energy, and in antioxidant functions, including those of the immune system. There is a mutual competition with zinc for uptake.

Species and even breeds of animals may vary in the amounts of copper that they absorb, that satisfy their requirements, and that result in toxicity. Copper requirement increases in infections because of the need for iron transport out of the blood. Symptoms of deficiency include anemia and poor growth/pigmentation of keratin structures.

Although excess dietary levels can be toxic, subtoxic amounts of copper sulfate are sometimes used as an antimicrobial agent in feeds. Toxicity is signaled by liver, kidney, and gastroenterological malfunction, and by greenish discoloration of those tissues/organs.

Dietary sources of copper include liver, shellfish, and legumes, although levels in foods are variable, depending on species and provenance. Milks of various mammals can be dramatically different not only in their macronutrient composition, but also in their levels of microminerals. For example, cows' milk is very low in copper compared to many other milks, and it can cause copper deficiencies when fed to wild species.

Zinc is required in more enzyme systems than are all of the other microminerals combined. It is part of every class of life-sustaining biochemical reaction, and is involved in disposal of CO_2 and harmful free radicals, breakdown of complex food molecules, and synthesis of nucleic acids (DNA and RNA). It regulates gene expression, and is involved in immune responses, wound healing and tissue integrity/growth, olfaction and taste, insulin function, and much more.

Since it is needed for so many reactions basic to life, deficiency symptoms include stunted/abnormal growth in young animals, while adults may exhibit decreased appetite, blunted olfaction/taste, and dermatitis/keratosis. Nutritionally significant amounts of zinc are found in many animal-based foods, with oysters being a particularly rich source. Zinc is a relatively nontoxic metal, but it has poisoned many a companion bird that chewed on galvanized wire caging.

Manganese activates a large number of enzymes, but its most notable role is in the formation of mucopolysaccharides, which are components of, among other things, connective tissue and cartilage.

Growing animals with manganese deficiencies from inadequate diets exhibit skeletal abnormalities, as observed in young birds of prey fed eviscerated pigeons; liver is a much richer source than muscle. There are diverse other deficiency symptoms, but deficiencies are

very uncommon from diets of whole foods because the mineral is widely present in foods of both plant and animal origins.

Selenium is a nonmetal mineral whose role as an antioxidant is central in the body's disarming of harmful free radicals. Free radicals can harm membranes of cells, as discussed in a previous column.

Selenium has less defined roles in the processing and detoxifying of various substances by the liver, and in immune responses, enzyme activation, and DNA repair. Recall that its levels in soil vary throughout the world, from deficient to toxic. Plants do not require selenium, but they absorb it passively from the soil or, in some cases, actively accumulate it as a toxin. It is chemically related to sulfur, and toxicity at excess levels results from its incorporation into amino acids that normally contain sulfur.

One symptom of selenium deficiency is "white muscle disease" (not to be confused with capture myopathy, although it can also be precipitated by strenuous exercise), in which cell membranes rupture and muscle tissue dies.

Good sources of selenium include organ meats, seafood, and whole grains.

Iodine (as the iodide ion) is a nonmetal mineral in the same family as chlorine and fluorine. It is a component of hormones (prominently thyroxine) made by the thyroid gland. In homeotherms (warm blooded animals), thyroid hormone is required for normal growth and brain development, and for maintaining normal basal metabolic rate and heat production. Thyroxine has a fascinating role in amphibians, where it is responsible for the metamorphosis of larval forms (tadpoles) to adults.

The most obvious sign of iodine deficiency is goiter, or enlargement of the thyroid gland in response to low levels of thyroid hormone. Subnormal levels of thyroid hormone, from any cause, result in lethargy, lowered metabolic rate and obesity, and keratinization/pigmentation abnormalities.

Like selenium, iodine is not essential for (or regulated in) plants, so its presence in them is largely a product of soil levels, which are quite variable. Unlike selenium, it is almost never encountered at toxic levels in nature. Iodine deficiencies, however, are common and widespread in even natural diets. Many captive diets require supplementation. In addition to low iodine levels in the natural environment, animals may face the problem of eating *goitrogens*, substances in plants that inhibit iodine uptake or thyroid hormone synthesis. Uncooked cruciferous vegetables and legumes are particularly rich in such compounds. Marine plants and animals are reliably rich sources of the mineral.

Toxicity from oversupplementation of iodine can, paradoxically, produce symptoms similar to deficiency, so care must be taken in regulating dietary amounts.

Fluorine (as the fluoride ion) is needed for mineralization of teeth and bones. Deficiencies are not common or well characterized, though it is clear that adding fluoride (to drinking water, for example) dramatically reduces dental caries in humans. Animal-based foods are the best fluoride sources.

Fluorosis, or fluorine toxicity, has been well documented in animals, generally as a result of human activity or error. Symptoms are tooth and skeletal fragility, and other effects similar to those caused by a deficiency of calcium.

Chromium is required for the normal function of insulin, the hormone that controls uptake of glucose ("blood sugar") into cells. In human diets, there is evidence that chromium deficiencies may be widespread, although some forms of supplementation may be risky, and toxicity can occur with one form of the metal (Cr^{+6}, as opposed to the much safer form of Cr^{+3}). Brewer's yeast, mushrooms, organ meats, and whole grains are good sources of chromium.

Molybdenum is needed for the activity of some enzymes that perform oxidation/reduction reactions in intermediary metabolism. Organ meats and legumes are some of the better sources for this mineral. Deficiencies are unlikely, but toxicity, evidenced by gout, is possible in areas where soil levels are very high.

Cobalt is required in small amounts by all animals, as a part of vitamin B_{12}. It is needed as a metal only by ruminants, because their intestinal flora synthesize the host's B_{12}, along with the other B vitamins. All other animals require the vitamin preformed in their diet; although it is also made by intestinal flora in nonruminants, the amount absorbed from that source is apparently low. Deficiencies of cobalt have been observed in domestic livestock, but not in free-living wildlife.

Nickel, Silicon (for connective tissues), **Vanadium, Boron** (for bone formation), and possibly **Arsenic** are needed in extremely small amounts. They are present in the general environment, and deficiencies are nearly impossible. Toxic excesses can be present in "natural" sources (e.g., arsenic in drinking water), but are generally human-caused.

Geophagy (eating of dirt or clay) is nearly universal in the animal kingdom, and dirt can be an important source of many minerals. However, dirt varies enormously in its mineral makeup, and clays can bind many chemicals, including dietary minerals. Thus, eating dirt does not offer a simple picture of mineral acquisition.

Microminerals play crucial roles in the most fundamental processes of life. All vertebrates require them for the same basic purposes, and most of them are necessary to all animals, vertebrate or not. Their ubiquity in the animal kingdom indicates their incorporation early in our evolution; following their roles through the phylogenetic tree is one more reminder that humans and all other animals share both a rich history and a common destiny. JWR

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

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NEO-REHABILISM...

zoonotes
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COLUMN

Open Minds

MAINTAINING DISCIPLINE AND FOCUS IN YOUR AUDIENCE

by Beth Dillingham

You have just arrived at an elementary school to give a presentation on rescued wildlife. You have been led to the gymnasium, where the school has set up a few tables, and so you start to haul large cages and materials in from your car. You are tired and more than a little stressed. The first of 150 kids start to arrive. There are preschool kids sitting next to fifth graders. You are wondering how on earth you will talk to such a diverse age group. The teachers are all in the back of the room talking to one another. The noise of shuffling bodies and young voices is deafening. The kids are wild because they just came in from recess and this is the last day before the winter break. One boy kicks another and bumps the table holding your animal.

OK—you get the picture. Anytime you make an effort to educate people, you may face inappropriate behavior and situations. Particularly when you have live animals with you, you will need strategies to create some control and focus in your audience.

First of all, ***schedule your visits carefully.*** Don't try to give a school program during the week of Halloween. Kids are so hyped up on candy, it is an uphill battle to work with them. The week before the winter holidays, spring break, or summer vacation should also be avoided. Be prepared for restlessness if there is a sharp turn in the weather or the spring winds have begun. Also, try to avoid being placed in cafeterias or gymnasiums, where the acoustics can be terrible. I like classrooms or carpeted libraries the best. Request smaller group sizes and try to avoid a wide range of ages in any one presentation.

If you are working with young people who regularly spend time together as a group/ class, they will have an established culture of behavior. The individual members will behave very differently when by themselves than they do in the group. ***Pay attention to the group culture; try to learn how the group is used to refocusing.*** Some teachers count, some raise two fingers and the whole room gets quiet.

Try to always engage the whole group so that none of the individual group members feel as if it doesn't matter if their attention wanders. Project your voice so that everyone can hear you, and avoid addressing just one person, even in answering a question. Repeat questions for the whole group and give the answer to everyone.

If you are working with a school group you may find classes that are well disciplined and teachers who have great control of their students. Or you may find just the opposite. Whatever the situation, ***the teacher should remain in the room with you during your work with the students.*** They are ultimately responsible for the students' behavior, and their absence can create liability issues for you. They are also your best ally in your education efforts, as they are the ones who will reinforce your message with the students after your leave.

Make sure you talk with the teachers about the kind of conditions and behavior you require. Enlist them early: "I will need the students to be very quiet and still before I can bring out these animals." Be clear about your needs, and they will understand that you expect them to play a strong role.

From the beginning, ***be positive but clear about your expectations.*** For instance, it is natural for people to want to touch the animals. Explain right at the start why they can't—it causes stress to the animals, oils from your hands damage feathers, and so forth. It is helpful to create a physical barrier, such as a table, to prevent the kids from touching or bothering the animals. I like to let groups come up close and file past the animals, keeping the animals where they are visible but out of reach. I ask very little kids to keep their hands in their pockets as they walk by. I do, however, let them touch the hides, skulls, feathers, and other items I bring, if possible. This helps to safely satisfy their tactile curiosity.

Animals open people up. Both kids and adults always seem to want to share stories about their own encounters with animals. This is a great sign; it means that you have reached them on a very personal level. However, sharing stories can be deadly to the focus of your presentation. When it comes time for questions, I ***always talk to kids about the difference between a question and a story*** first. I tell them that I would love to hear their stories later—so that they know I think that their experiences are important—but that right now we are only going to answer questions.

If you have done your work assessing the classroom, setting clear expectations for behavior, and enlisting the help of the teacher, but you still have problems, ***don't be afraid to use the silent treatment:*** "I am sorry, but it is too noisy for me to continue; I am afraid that the noise is going to stress the animals. I am going to stop until it gets quiet." Wait until it is *really* quiet before you continue. (I wait until I almost can hear a pin drop.) It may take a while, but eventually it works. I always save bringing out the animals for last. Because the kids don't want to miss that, they quiet down.

In the rare instance where asking for silence does not work, get ready to pack up and go. There is no point in continuing, and this experience will help those kids learn to settle down in the future. I tell them, "I am sorry you are missing a real treat, but I will not bring an animal out when it will be frightened by noise."

Despite all the struggles and interesting circumstances you face doing presentations in schools, please continue. You are making a big difference. I have heard many kids tell how "meeting" a bird or a prairie dog and learning about the problems the animals encounter changed their behavior toward animals forever.

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.



JOB ANNOUNCEMENT:
Executive Director

The International Wildlife Rehabilitation Council (IWRC) is accepting applications for the position of Executive Director. We require an enthusiastic, imaginative individual who likes to interact with rehabilitators and other wildlife professionals and who can "hit the ground running." Some travel is required, as the Executive Director will attend conferences and meetings as IWRC's representative. If you enjoy the excitement of international wildlife rehabilitation and the challenge of working with a vibrant, growing organization, drop us a line!

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  - promotion and support for skills training classes
  - supporting the Publications Committee for the publication of the *Journal of Wildlife Rehabilitation* and other materials
  - supporting the Conference Committee to coordinate the annual conferences
  - accurate accounting of income and expenses
  - regular reports to the Board of Directors
  - work with the Board to modernize and automate office operations, including membership, conference and class registration, and other similar functions
  - investigate and apply for potential financial support from foundations, corporations, and other appropriate sources
  - coordinate with Board and Board-appointed committees to carry out full range of IWRC operations

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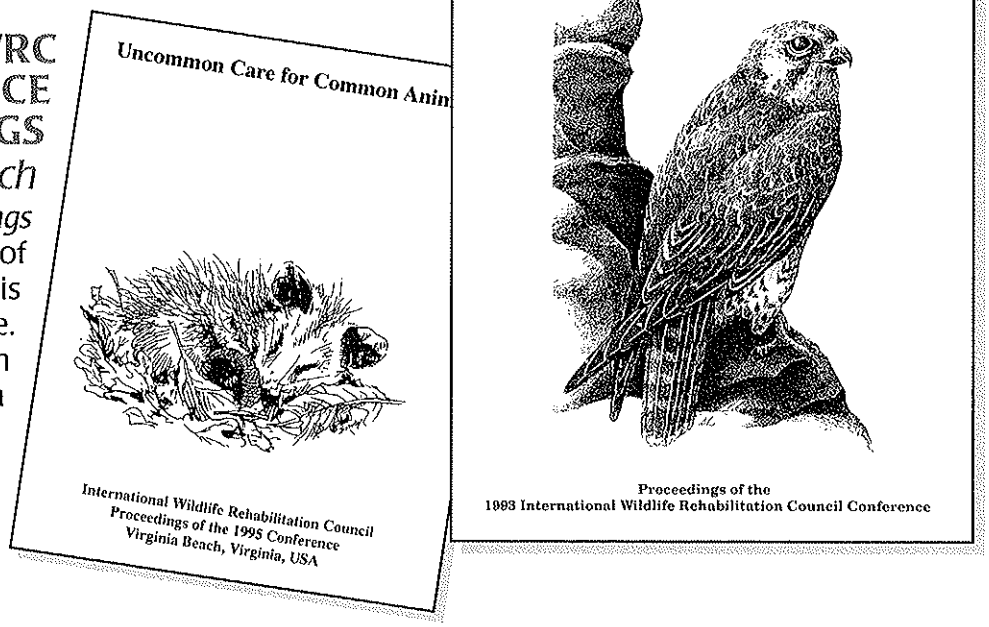
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FACT SHEET

Rehabilitation Notebook:

AVIAN BOTULISM ("LIMBERNECK")

Causative Agent

Disease results following ingestion of a toxin produced by *Clostridium botulinum*, a common environmental bacterium which grows in the absence of oxygen. Several toxins have been identified, but type C is the most common culprit in avian disease.

Clinical Signs

This disease causes progressive flaccid paralysis (legs, wings, neck, respiratory muscles, death). Birds may be seen propelling themselves across the water with their wings, due to paralysis of the legs. Paralysis of the inner eyelid, as well as weakness and drooping of the neck are also seen ("limberneck"). This may lead to drowning if the bird is in the water. On land, respiratory paralysis and death follow.

Hosts

Type C toxin:

- Wild birds, especially waterfowl
- Cattle
- Horses
- Poultry

Type E toxin:

- Fish-eating birds

Transmission:

Appropriate environmental factors, such as temperature, water pH and the presence of decaying organic matter cause the spores to germinate and the anaerobic C. *botulinum* bacteria to grow. The neurotoxin produced does not affect insects that feed on the decaying matter (often carcasses). The toxin concentrates within the body of the insects (commonly maggots), which are then eaten by the waterfowl. Death of the birds ensues, providing more organic matter with which to continue the cycle.

Seasonality

Optimal temperatures for the germination of C. *botulinum* spores occur most commonly in summer and fall.

Diagnosis:

Appropriate environmental factors combined with typical clinical signs can lead to a diagnosis of avian botulism. Confirmatory tests include a mouse protection assay, in which serum from a sick or freshly dead bird is injected into mice. Mice that have been given antitoxin survive, while the unprotected mice become affected. A tabletop test (ELISA) is also available.

Treatment

Affected birds should be provided with plenty of fresh water and shade. Care must be taken to avoid drowning in birds with neck paralysis. Other supporting care such as tube feeding and parenteral fluids may be necessary. An antitoxin is also available.

What You Can Do to Help

- Protect wetland areas from organic pollution (wastewater, pesticides, fertilizers), which may rapidly kill aquatic animals.
- Remove accumulated decaying matter, both plant and animal, from shores.
- Avoid rapid changes in water depth, which may lead to the death of fish and accumulation of organic debris.
- Notify the proper authorities should unusual death of waterfowl be noted.

Public Health Considerations

Type C botulism has never been reported as a cause of illness in humans; however, humans are susceptible to other botulism toxins. Thorough cooking destroys botulism toxins in food.

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 Birds of Heaven: Travels with Cranes*

by Peter Matthiessen
paintings and drawings by Robert Bateman

Reviewed by Elsa C. Bumstead

New York: North Point Press, 2001
350 pp.; $27.50 U.S. (hardcover)
ISBN: 0-374-19944-2

"The immortal cranes call, their cries sound from afar, their thoughts circle upward into distant skies. Below, on the autumn rivers, stands a man, above him the bright moon. The man wanders aimlessly, trailing after the endless Milky Way. The wind blows past him. I, too, thinks the man, would like to be utterly free."

—Jiang Yi Ning, as quoted by Peter Matthiessen in *The Birds of Heaven*

Imagine, if you will, traveling the globe in search of cranes, all fifteen species. That's what Peter Matthiessen did over a period of years. This book chronicles those journeys, providing a masterful overview of ubiquitous cranes, their behaviors and habitat requirements, their endangered ecosystems and importance in the legends of the world's peoples.

The story of the cranes unfolds in Siberia along the Black Dragon River as Matthiessen reveals that the lesser sandhill crane of North America migrates across Alaska and the Bering Strait to breeding territories in Siberia. In that part of the world the sandhill crane becomes known as the "Crane from the East." And so it goes. Travels along the Ussuri and Amur Rivers reveal international disputes concerning the creation and preservation of wildlife reserves in regions where pressures for economic development have allowed mining, timber, oil, and gas operations and water supply rights to compete strongly with ecotourism. Geopolitics are revealed as "a critical factor in crane survival." Not all breeding grounds and migration routes are known. That has been one part of Matthiessen's mission with his scientist buddies: to find those missing pieces of the jigsaw puzzle of gruiform natural history so that better plans can be made to ensure species survival in an increasingly competitive world.

Matthiessen travels on in search of various cranes—to the Daurian Steppes, to Gujarat and Rajasthan in northwestern India, and to "the end of Tibet." From there to Bhutan to the Nine Rivers area (Jiujiang) of the Yangtze River in southeastern China, and on to Hokkaido in northern Japan and the "accidental paradise" of the demilitarized zone between North and South Korea. Northern Australia is next as he goes in search of the brolga, the only crane thought to exist on that continent. But in March 1961 came the discovery of a flock of sarus cranes (a race thought to have disappeared during the years of warfare in Southeast Asia) on the Atherton plateau and points along the Gulf of Carpentaria.

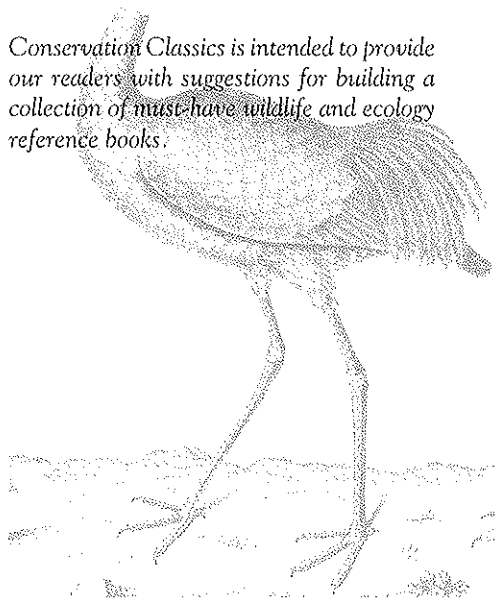
After Australia comes Africa, where the presence of cranes is explored in Equatoria, Ngorongoro, Okavango, and the Transvaal. Europe is next, where the focus is on the discovery of the return of the Eurasian crane to England as a breeding species after an absence of more than three centuries. Matthiessen then wings across the Atlantic to North America, where the importance of the crane to Native American tribes in their traditions is discussed. The work of the International Crane Foundation unfolds, and the significance of various national wildlife refuges and sanctuaries to the sandhill and whooping cranes is revealed. At the end of the book is a chart of the evolution and radiation of the cranes (assembled with the help of Dr. Carey Krajewski and Dr. George Archibald). It provides a useful resource for those interested in crane origins in the context of geologic time.

Natural history information is interwoven among the travel accounts. Gruiformes is the taxonomic order to which cranes and their New World relatives, limpkins and trumpeters, as well as cosmopolitan jacanas, rails, gallinules, and coots, are assigned. The reader becomes acquainted with such terms as "umbrella species," "sentinels of heaven," "omens of longevity," and "symbols of good fortune." Physical attributes of the Gruiformes are discussed. Bills, feet, feathers, postures, behaviors, sounds, and archaeological remains are examined.

Why a "Conservation Classic?" The material in this book is a wealth of knowledge about the current status of cranes worldwide. As an umbrella species, cranes have broad habitat requirements and amazing migratory patterns that are threatened by ever-expanding human activities. As wildlife rehabilitators work with orphaned and injured wildlife, it is imperative to think about suitable natural areas in which to release recovered "patients." To that end, conservationists need to work in teams across political boundaries to create sizable "island" sanctuaries with appropriate linkages to allow species to survive as they migrate. This book is an inspirational example of international conservation efforts that needs to be read. And while you are at it, enjoy the crane portraits rendered by artist Robert Bateman. Then, and only then, put it on your bookshelf. JWR

Reviewer Elsa C. Bumstead is an interpretive naturalist, writer, environmental scientist, and sometime wildlife rehabilitator 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.



Clinical Textbook for Veterinary Technicians

Fifth Edition

by Dennis M. McCurnin, D.V.M. and Joanna M. Bassert, V.M.D., eds.

2002: W.B. Saunders Company
944 pp; U.S.$69.95

As a career veterinary technician, I first encountered this textbook as a student some years ago. This newest edition has many changes, additions, and improvements to the 1985 version that was part of my curriculum's required reading list.

Although this text was written as a reference and teaching book for veterinary technicians and students, many parts can be utilized as well by the wildlife rehabilitator who has an interest in the medical aspects of animal care. A rehabilitator with an understanding of the mechanics of relevant veterinary procedures is in the position to offer animals better care by using this knowledge to make more educated decisions. Not all types of domestic animal veterinary procedures are appropriate for use with wildlife, and the rehabilitator who is familiar with all the options will be better prepared to choose the optimal method.

For the wildlife rehabilitator, this book contains 37 chapters that include information ranging from little to high pertinence. Many chapters, such as Wound Management, Bandaging, Basic Necropsy Procedures, Parasitology, and Diagnostic Imaging, are applicable to all animal species. Other chapters—for instance, Food Animal Medicine, Client Bereavement, and Animal Behavior—only pertain to domestic animals and have little relevance to rehabilitators.

The Restraint and Handling of Animals chapter includes a section on exotic pets and discusses restraint of passerine birds, raptors, reptiles, rodents, and small mammals for examination.

The chapters on Birds, Reptiles and Small Mammals and on Zoonoses and Public Health are especially relevant and informative.

Even though the animals pictured are of dogs and cats, the concepts in the chapters titled Companion Animal Clinical Nutrition, Small Animal Medical Nursing, and Pain Management can be extrapolated into many animal species.

For the rehabilitation center with a veterinary clinic, this text includes important and practical information and regulations on medical inventory, equipment maintenance, record keeping, and occupational health and safety within the hospital.

The authors cover a comprehensive collection of topics in this book. Although some subjects are rather briefly introduced, the authors do offer a list of recommended readings at the end of each chapter for the reader who wants to learn more.

Most of the subject matter introduced in this textbook that is of use to wildlife rehabilitation is also available in a multitude of literary works. However, few single sources contain this range of contents under just one cover. JWR

Reviewer Melanie Haire is the senior veterinary technician at Zoo Atlanta and a state and federally licensed wildlife rehabilitator.

Red-Tails in Love:

A Wildlife Drama in Central Park

by Marie Winn

1998: Vintage Books, a Division of Random House
317 pp; U.S. $ 13 (paperback)

Do you know anyone in New York who is at all interested in nature? Human nature or all Mother Nature's children? For them, this book is a "must read." It's also a must read for those nonfiction lovers who are really romantics at heart, or any of us who have visited Central Park. While it's called *Red-Tails in Love*, it could easily be called *Marie Winn in Love*, or better, *New York Birders in Love*.

The object of all this affection is actually Central Park, particularly its sometimes neglected and "wild" places where Nature has an opportunity to make habitat of what most humans, momentarily, overlook. A recurring theme throughout is change: change of seasons, change of players, change of landscape, and change of emotions. Whereas most users of Central Park think sludge and mud from a drained turtle pond anathema, the nonhuman residents of the park (and those who spy on them with binoculars) find it a haven of new resources. Ibis, egrets, and killdeer seize the opportunity and enjoy the mud right up until the 'dozers dig it all up. Winn describes the behavior of the killdeer—parent and children—in the presence of the backhoe with great tenderness and humor. In fact, the whole book is full of tenderness—along with a realistic dose of predatory blood.

Winn includes official maps of Central Park and a Birder's View of the Ramble, where most of the activity takes place. In fact, she speaks with some satisfaction of realizing people use her book; as she's in the park, she sees them using the endpapers' maps.

Winn describes her introduction to the "Regulars" who keep a close eye on creatures great and small. She names names and describes characteristic glimpses of these birdwatchers and their relationship to *The Bird Register*, an *ad hoc* volume kept in a public place so that observations can be recorded and shared by anyone interested.

She speaks in detail about the original dream of the park, in the mid 1800s—and its design, land use, landscape, and maintenance over the years. How the plan was to create "an improvement of the wild, a carefully fashioned landscape where city dwellers could come and enjoy the illusion of wilderness without any of its inconveniences or dangers." She describes how the carefully imported and cultivated exotic vegetation has turned into NNIPS (nonnative invasive pest species). And she explains how the evolution of the city and demand on the depleted budget allowed the Ramble to manage itself, much to the distress of certain strictly horticultural interests. In 1981 the Central Park Conservancy mounted an elaborate and expensive plan to return the Ramble to some its former formality. This would have required taking out old and familiar trees. The public outcry led by bird watchers resulted in abandoning the plan, and the Conservancy has now taken an "interest in the woodlands as a wildlife habitat second only to the bird watchers' own."

One hundred and twenty-four species of birds have been counted on a single day at the height of a spring migration; 190 species are included in the annual list in the back of the book. In addition, there is a butterfly list, a damsel and dragonfly list, a hawk migration list, a list of edible plants, and an annotated bibliography, as well as acknowledgments and index.

Little details and victories of like-minded people are always fun for a birdwatcher or rehabilitator to read about. Even more fun was to read that, after 119 years of history, a pair of hawks, apparently urban red-tails, were building a nest on the 12th floor of a building at the edge of Central Park. Pigeons can make a building ledge work for a nest, but big buteos? The structure that retained the sticks of the nest on the ledge was a row of spikey pigeon deterrents! How's that for irony?

The not-fully-mature-by-plumage male and his older mate tried to establish residency in the neighborhood. The corvid population, however, was not hospitable and drove the lady to distraction. After about three months of constant mobbing, she flew into a high-rise on 5th Avenue and 73rd Street. Enter Vivian Sokol. I know Vivian Sokol! She's a rehabilitator in Manhattan. This book is beginning to read like a letter from home. It turns out the male, now referred to as Pale Male, was also mobbed into a building on 62nd Street near Madison Avenue. He, too, went to Vivian, who was able to treat him for an impact injury and release in a few days. The female was badly injured, however. She went to Len Soucy.

Well, we know Len Soucy, too, don't we? More recognizable names popped up connected with other threads in this remarkable story of love, loss, reunion, birth, and rebirth. Ward Stone became involved in a question of poisoning, the report from the state lab characteristically arriving a year after the event.

The part of this book that first engaged my affection, after the mention of Vivian Sokol, is the way Marie Winn explained the tendency of people to anthropomorphize, particularly in the giving of names. I have a personal peeve about referring to the educational bird "Merlin" who is actually a great horned owl. I hate it when the child at the State Fair says of the red-tailed hawk, "I know that bird; that's Alice!" But even I am willing to accept Winn's explanation: "Calling hawks by given names, it should be said, was not an example of soppy sentimentality among the bird-watchers; it was a matter of convenience. Much easier to say Pale Male than 'the light phase red-tailed hawk'. Similarly, quicker to say Chocolate than 'the new female mate of the light phased (sic) red-tailed hawk' It was around this time that the Regulars began to refer to the original female as First Love."

I'm not going to recount the whole story, though I'd like to. The journalism is expert. There is none of the usual slightly misunderstood science so frequent in the popular press; arcane expressions and concepts are beautifully and sensitively explained. The story contains two of what this *Journal* likes to call Success Stories. Both female red-tails passed through Len Soucy's Raptor Trust to be released and deliver their genes to the next generation. One of them was blind in one eye.

It's a story of a few actors at the top of the food chain and the hazards and risks of living there. It's a story of the whole chain, from seed and rodents to plants, insects, and songbirds. It's a story of human passion and joy in nature. It's a detective with the evidential proof documented at the Bird Banding Laboratory and in Central Park. It's complex. Read it and exult! JWR

Reviewer Penny Elliston is a wildlife rehabilitator now living in the Southwest. She has a great fondness for New York City and its diversity, and even says, "some of my best friends are New Yorkers."

AVIAN SPECIES

Carotenoid Pigments in Male House Finch Plumage in Relation to Age, Subspecies, and Ornamental Coloration

C. Y. Inouye, G. E. Hill, R. D. Stradi, and R. Montgomerie

The Auk 118(4): 900–15.

Like males of many bird species, male house finches (*Carpodacus mexicanus*) have patches of feathers with ornamental coloration that are due to carotenoid pigments. Within populations, male house finches vary in expression of ornamental coloration from pale yellow to bright red, which previous research suggested was the result of variation in types and amounts of carotenoid pigments deposited in feathers. The authors used improved analytical techniques to describe types and amounts of carotenoid pigments present in that plumage. They then used those data to make comparisons of carotenoid composition of feathers of male house finches at three levels: among individual males with different plumage hue and saturation, between age groups of males from the same population, and between males from two subspecies that differ in extent of ventral carotenoid pigmentation (patch size): large-patched *C. m. frontalis* from coastal California and small-patched *C. m. griscomi* from Guerrero, Mexico. In all age groups and populations, the ornamental plumage coloration of male house finches resulted from the same 13 carotenoid pigments, with 3-hydroxy echinenone and lutein being the most abundant carotenoid pigments. The composition of carotenoids in feathers suggested that house finches are capable of metabolic transformation of dietary forms of carotenoids. The hue of male plumage depended on component carotenoids, their relative concentrations, and total concentration of all carotenoids. Most 4-keto (red) carotenoids were positively correlated with plumage redness, and most yellow carotenoid pigments were negatively associated with plumage redness, although the strength of the relationship for specific carotenoid pigments varied among age groups and subspecies. Using age and subspecies as factors and

concentration of each component carotenoid as dependent variables in a MANOVA, the authors found a distinctive pigment profile for each age group within each subspecies. Variation in pigment profiles of subspecies and age classes may reflect differences among the groups in carotenoid metabolism, in dietary access to carotenoids, or in exposure to environmental factors, such as parasites, that may affect pigmentation.

Behavioural and Physiological Effects of Absence of Ultraviolet Wavelengths for Domestic Chicks

S. A. Maddocks, I. C. Cuthill, A. R. Goldsmith, and C. M. Sherwin
Animal Behaviour *62(5):* 1013–19.

It is increasingly clear that ultraviolet (UV) wavelengths are a component of normal avian color perception and influence their behavior. As artificial lighting is designed to human specifications, and so is usually deficient in UV light, there may be welfare implications for captive birds, with both context-dependent and chronic long-term effects in its absence. Domestic chicks (*Gallus gallus domesticus*) kept under UV-deficient environments had significantly higher basal plasma corticosterone concentrations and tended to explore less, although not significantly so, suggestive of suboptimal conditions. Chicks under full spectrum lighting had a significantly higher rate of corticosterone rise in response to capture and handling stress than chicks reared without UV, largely because a similar maximum level was reached from lower initial concentrations. These treatment differences in hormonal stress response tended to diminish with age and/or familiarity with humans, in both groups of birds.

NEO-REHABILISM...

stonicity
the proper balance of dirt and stones in the bottom of your mews

MAMMALS

Seasonal Effects of Food Provisioning on Body Fat, Insulin, and Corticosterone in Free-Living Juvenile Belding's Ground Squirrels (*Spermophilus beldingi*)

S. Nunes, E. Muecke, and K. E. Holekamp
Can. J. Zool./Rev. Can. Zool. 80(2): 366–71

The authors evaluated the relationship between body fat and the metabolic hormones insulin and corticosterone in free-living juvenile Belding's ground squirrels (*Spermophilus beldingi*). Some free-living juveniles were provisioned with extra food high in fat and calories, and unprovisioned juveniles were used as controls. Body fat (as a percentage of body mass) of squirrels was regularly evaluated using noninvasive methods. Blood samples were also regularly collected from juveniles and assayed for plasma concentrations of insulin and corticosterone. Provisioned juveniles were fatter than unprovisioned juveniles during most of the active season, but differences in body fat disappeared near the end of summer as juveniles began fattening for hibernation. Thus, the data indicate that although body fat may fluctuate with energy availability early in the active season, it is regulated at precise levels as squirrels prepare for winter. Plasma corticosterone concentrations did not differ between provisioned and unprovisioned juveniles. However, plasma insulin concentrations were greater in provisioned than in unprovisioned juveniles early in the summer. Differences in insulin concentrations disappeared later in the active season, just prior to the disappearance of differences in body fat. Moreover, plasma insulin concentrations were significantly correlated with subsequent changes in body fat. Thus, the data suggest a link between insulin and seasonal regulation of body fat in juvenile *S. beldingi*. *(Abstract ©2002 NRC Research Press.)*

PESTICIDES

Assessment of Risks of Brodifacoum to Non-target Birds and Mammals in New Zealand

C. T. Eason, E. C. Murphy, G. R. G. Wright, and E. B. Spurr
Ecotoxicology 11(1): 35–48

The risks to nontarget birds and other wildlife from the use of vertebrate pesticides, including anticoagulant rodenticides, are determined to a significant extent by species' intrinsic susceptibility, and the toxicokinetics of the compounds used. Brodifacoum is highly toxic to birds and mammals. The acute toxicity of brodifacoum to birds in New Zealand varies from <1 mg/kg in pukeko (*Porphyrio p. melanotus*), the native swamp hen, to >20 mg/kg in the paradise shelduck (*Tadorna variegata*). Like other second-generation anticoagulants brodifacoum is strongly bound to vitamin K epoxide reductase and will persist, apparently for at least 6 months, in organs and tissue containing this enzyme (e.g., liver, kidney, and pancreas). The unique toxicokinetics of this class of compound exacerbates the risk of primary and secondary poisoning of nontarget species. Vertebrate pest control programs in New Zealand using bait containing brodifacoum have resulted in the primary and secondary poisoning and sublethal contamination of nontarget species. These include native raptors, such as the Australasian harrier (*Circus approximans*) and morepork (*Ninox novaeseelandiae*), other native birds such as the pukeko, weka (*Gallirallus australis*), southern black-backed gull (*Larus dominicanus*), and kiwi (*Apteryx spp.*), and introduced mammals, including game animals. There are increasing numbers of reports worldwide of wildlife contamination and toxicosis after the use of second-generation anticoagulants. All pest control activities require careful risk–benefit assessment in view of their potential to cause adverse environmental impact. Monitoring of wildlife for pesticide residues will provide data that can be used to reduce the risk of anticoagulant bioaccumulation and mortality in nontarget species. *(Abstract ©2002 Kluwer Academic Publishers)* JWR

Condors Return to Mexico

Six endangered California condors were recently transported to Tijuana, Mexico, marking the first time the species has been documented in Mexico since the late 1930s. The condors are part of a recovery program that is being implemented by the USFWS in cooperation with several U.S. and Mexican partners.

Five of the birds are juveniles that will be released in the mountains of northern Baja California, Mexico. The sixth, an adult female, is accompanying the juveniles as a "mentor" bird; she will return to the Los Angeles Zoo following the release. All six were reared at the Los Angeles Zoo and were hatched at the zoo and the Peregrine Fund's World Center for Birds of Prey in Boise, Idaho.

"By virtually eliminating human contact and providing adult mentor birds as role models, we have refined our rearing techniques for chicks not raised by their parents. This has produced birds that are confident interacting with other condors yet wary of humans and human activities," said Susie Kasielke, curator of birds at the Los Angeles Zoo.

The condors re-introduced to Mexico may one day unite with condors in California to form one population. The California Condor Recovery Program seeks to establish two geographically separate populations, in California and in Arizona, each with 150 birds and at least 15 breeding pairs. There are 76 condors now living in the wild in California and Arizona, 16 in field pens ready for release, and 116 in captivity.

Prior to the release, Mexican biologists will visit California to learn about the latest condor-care and monitoring techniques. An outreach program will work with local Baja communities and ranches to educate and inform them about condor re-introduction efforts. JWR

Off-Road Vehicles Destroy Habitat

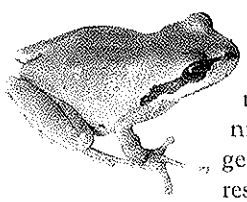
The growing popularity of off-road vehicles (ORVs) has proven a disaster for wildlife and ecologic diversity throughout the United States and elsewhere. A 90-page report by the Defenders of Wildlife documents the situation in Florida's national forests, where ORV drivers have ripped thousands of miles of outlaw trails through ecologically sensitive areas, in the process destroying, fragmenting, or degrading critical wildlife habitat. The victims include salamanders, bald eagles, the imperiled Florida black bears, and red-cockaded woodpeckers. The report is available at www.defenders.org/habitat/florvs/ JWR

Froggy Went a Countin'

A recent study published in the online issue of *Nature Neuroscience* finds that frogs can count the number of times a burst of sound is repeated in a call, an ability that helps them recognize friends and foes.

In many frog species, males communicate using sound bites interspersed with regular pauses, such as the brief silence between "rih" and "bit." The length of the pause is important: male Pacific tree frogs, for example, use a slow call to intimidate other males and a fast trilling to attract females. Several years ago, researchers discovered individual nerve cells in the frogs that would fire in response to simulated frog calls of different lengths. In the current study, neuroethologist Gary Rose of the University of Utah and colleagues wanted to determine what components of the sound the neurons were paying attention to.

The team played computer-generated calls to male frogs and recorded electrical impulses from neurons in the sound-processing region of their brains. They learned that each neuron was tuned to its own optimum number, between four and 12 pulses. When the researchers varied the length of pauses between tones, the frog neurons only discharged when the intervals were constant, suggesting that the neurons count the spaces between throbs. In addition, a neuron that normally fired after nine pulses would fail to shoot if the team altered the interval length between pulse eight and nine. The neuron required another nine repetitions, suggesting it had been reset to zero. JWR



The Value of Nature

The current rate of habitat loss is costing the world the equivalent of U.S.$250 billion every year. The loss of benefits provided by nature—including flood control, climate regulation, and nutrient recycling—far outweighs the benefits of converting the land to farms, housing, or other human uses, according to a study recently published in the journal *Science*. The study, by a team of U.S. and British researchers, found that an undeveloped ecosystem is worth an average of 82 percent more than the same land paved, clear-cut, drained, or otherwise developed. JWR

A New Standard for Conservation

The African nation of Gabon has announced the creation of a system of 13 new national parks on roughly 10,000 square miles of land. As a percentage of total land mass, this will be the largest park system in the world. Logging and other kinds of industrial development will be banned in the parks, which include some of the world's least spoiled and most threatened tropical forests.

The blueprint for the parks system was drawn up by the New York–based Wildlife Conservation Society (WCS). During 1999 and 2000 Michael Fay, a research scientist with the WCS and the National Geographic Society, walked from the eastern edge of Congo to the western edge of Gabon, viewing an incredible range of animals and their habitat as he traveled, including "Blue seas, white sand, elephants, whales, sea turtles, monkeys, bush pigs, unbelievable scenery," notes Fay.

Following the trip, Fay and photographer Michael Nichols met with Gabon President El Hadj Omar Bongo, who was deeply moved by Nichols' pictures. At the United Nations meeting on sustainable development in September, held in South Africa, Gabon announced the new parks system. JWR

Giving Wildlife a Break

Fall and early winter pose particular hazards for wildlife and motorists alike. Seasonal activities, from courtship to preparing for the cold months ahead, increase the likelihood that animals will have to cross roads. Help the public learn how they can reduce the likelihood of hitting wildlife by ordering a free supply of Give Wildlife a Brake!™ brochures from the Humane Society of the United States. Bumper stickers are also available. Contact Marney Finkle at 301/258-3112 or mfinkle@hsus.org. JWR

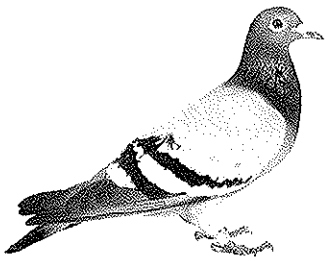
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A REPRODUCIBLE PUBLIC SERVICE ANNOUNCEMENT

A message from the

International Wildlife Rehabilitation Council

p e s t i c i d e = p o i s o n



WHAT IS A PEST?

An organism that is unwanted by humans.

Too many of anything is a pest.



Purslain? Dandelion?

A ladybug? A lacewing fly? A damsel fly? A butterfly?

A wasp?

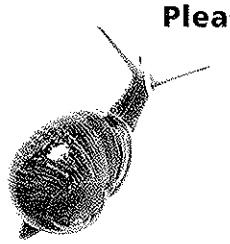


A blackbird? A red-tailed hawk?

Some h u m a n s *you know?*

Many wild and domestic animals are affected by poison. Some of them eat "pest species."
Some of them are also food for other species.
It is dangerous to all of us to put poison in the food chain or the water.

Please think carefully before you add artificial poisons in the form of pesticides to our planet.







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

TAIL END

by Astrid MacLeod



VIRGINIA OPOSSUM PHOTO BY PAT ISSACS

"Ride 'em, Cowboy!"

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.

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