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ABOUT THE JOURNAL

THE *JOURNAL OF WILDLIFE REHABILITATION* is designed to provide useful information to wildlife rehabilitators and others involved in the care and treatment of native wild species, with the ultimate purpose of returning them to the wild. The journal is published by the International Wildlife Rehabilitation Council (IWRC), which invites your comments on this issue. Through this publication, rehabilitation courses offered in numerous locations, and an annual symposium, IWRC works to disseminate information and improve the quality of care provided to wildlife.



Barred owl *(Strix varia)* on barbed wire. This raptor was successfully rehabilitated and returned to the wild.
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On the cover:
Hawksbill turtle *(Eretmochelys imbricata)*.
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EDITORIAL

The Director's View

I vividly remember a conversation I had with my father when I was about eleven years old. We were in his old, gray truck, driving to town on some errand or another, and he asked me what I wanted to do with my life. I stated that I wanted to work for an international environmental organization and travel the world helping animals. Imagine my surprise to find myself living that eleven-year-old's dream. I may not be traveling the world physically, but I am conversing with and helping people all over the globe.

I grew up in the woods of Wisconsin and Minnesota. My parents became involved in wildlife rehabilitation when I was nine. By twelve, I was a full-fledged rehabber, caring for songbirds and small mammals. I volunteered my summers to songbird and raptor care through the high school and into college, and grew interested in educational presentations. I began working with our non-releasable raptors and learned how to present an engaging talk.

At Lawrence University in Appleton, Wisconsin, I majored in Environmental Studies and in Anthropology. My experiences in rehabilitation led to a fascination of how humans perceive and interact with the world around them. I interned in the educational department of the Cleveland Metropark Zoo in Ohio and at the Wind River Wildlife Rehabilitation Center in Wisconsin, learning different paradigms of environmental education. My senior thesis was on the environmental philosophies of Australian zoo educators.

I have worked for a variety of organizations in the US, including environmental centers in Ohio and Washington and a food bank in Oregon. The last three years I spent in corporate America. These experiences have all brought me here, as director of IWRC.

My focus is on IWRC's educational mission as a global organization. I want to increase the international scope of IWRC. I plan to make it easier to access our classes worldwide, eventually extending them to the six, continuously populated continents. I hope to increase the international attendance at our symposium, ideally having it hosted outside of North America within the next ten years.

Education is what IWRC does, through our Journal, Symposium, and classes, and even through informal communication between our members. I see many opportunities to grow and enhance our educational abilities. Several years ago, we were pioneers in online classes; many advances have since been made in online education. We are exploring incorporating updated technology in our classes as we develop new classes and an entire curriculum. I find the possibilities thrilling.

On one hand, I feel like I have "made it" working at my dream job—on the other, I am excited because there is such a long way to go. I treasure this opportunity to work with the Board and our members to continue IWRC's pursuit of excellence and to help our organization grow with the needs of its constituents and the changes in education technology. ■

Kai Williams
Director, IWRC

Addendum: In the time since I drafted this editorial, the Gulf of Mexico has suffered a massive oil spill, which is ongoing. IWRC is assisting the wildlife rescue effort in a supportive role, helping to mobilize our members' volunteer efforts and answering the public's questions about wildlife rehabilitation and ways they can help with the disaster. Unfortunately, the wildlife of the Gulf area will be experiencing the effects of the spill for some time. IWRC stands ready to continue and expand our assistance in any capacity we are needed.

Up For Discussion: REHABILITATION PERMIT FEES

The Federal Aid in Wildlife Restoration Act (aka Pittman–Robertson Act, passed by the U.S. Congress in 1937) provides a mechanism for collecting and distributing federal aid to states for management and restoration of wildlife through an excise tax on sporting arms and ammunition. States contribute matching funds—collected primarily through the sale of hunting and fishing licenses—to receive this aid. The Act offered states their first source of income for enforcement of wildlife laws, for habitat protection, and for many other conservation programs, thereby creating Departments of Natural Resources (DNRs) as we know them today. Consequently, it gave hunters a powerful voice within the agencies… and that's the primary reason they supported the legislation.

The idea of charging a fee for rehabilitation permits arises periodically, especially when agency budgets are being squeezed—and not just in the United States. Rehabilitators who are against permit fees argue that, unlike recreational resource users, they provide a free and yet valuable service to both the public and to the agencies; therefore, even a small fee for rehabilitation permits is an unjust burden on a group that is already making sacrifices for the good of wildlife, the public, and the state agencies that oversee their work. Those who support permit fees argue that the benefits to be gained are worth the relatively small cost: "legitimization" of rehabilitation, a stronger voice within the agencies, and a source of funds to support research using the data collected on annual reports.

THE QUESTION:

Should rehabilitators support annual permit fees?

THE RESPONSES:

Oklahoma charges a US $10.00 per person annual fee, so the question is moot for me. However, the fee did not grant us a voice. They are not particularly responsive to our needs. If the fee were US $50.00 per year, I don't believe their attitude would change.

Ninety-eight percent of the Oklahoma Department of Wildlife Conservation funding comes from hunting and fishing licenses and special tags. The remaining 2% comes from the Pittman–Robertson Act. Providing another US $2,000 to their coffers (from rehabber fees) has not changed their charter or goals. They are game-animal goaled. Non-game animals get little attention.

Many people within the Oklahoma Department of Wildlife Conservation believe wildlife rehabilitation is a hobby of women who want to keep non-releasables as pets. They (as well as many wildlife professionals) believe there is no measurable positive impact to the wild population from our efforts. Apparently, they haven't read the starfish story.

Also, in Oklahoma, there is no state education permit. The law is silent on education. There is no permit, so no permitted educational entities. The Pittman–Robertson Act sends money to the states for habit restoration and habitat rehabilitation. I believe the Pittman–Robertson Act should be changed so some of the money would be earmarked specifically for state wildlife rehabilitation as well. It could go to a state-sponsored center, or be divided up to smaller centers.

Gary Siftar
Oklahoma Raptor Center
Broken Arrow, Oklahoma, USA

I like it when people bring up an issue and then ask for discussion of two alternatives. It means I can then throw in a third alternative! The issue, as I see it, is one of the opinion of administrators about rehabilitators. On the one hand, we save them a lot of work (dealing with the public, etc.) and they "should" appreciate us for that. On the other hand, we create a lot of work for them. I propose a third alternative to the "demand respect and no fees" or "pay them off to get respect" options. That is for rehabbers to set up a system to collect and manage their data for the regulators. Everyone can benefit from the technology and the rehabbers get points for organizing themselves and saving administrators a lot of work.

Current computer systems and automation make this sort of project thoroughly do-able. The hard part would be getting excellent programmers to design it, while communicating with various departments across the United States to decipher their requirements and systems. Rehabilitators would enter their information on the system where it would be stored for later use or analysis (imagine: a national data repository that researchers can access!). The system would then spit out a report to the rehabber's administrator according to that particular office's requirements, saving that officer tons of time on boring stuff.

Always look for those third options. Sometimes they're worth pursuing.

Marra Apgar, B.Sc.
Raptor Presentations and Perth Raptor Care
Perth, Western Australia

It seems, in my opinion, that the story of permits is remarkably simple. The single, reasonable use of permitting is to have some control over who is doing the job. Without permits, literally anyone… or no one… can take 'publicly owned'

OILED MURRE, UNALASKA, 2004. PHOTO © US FISH & WILDLIFE. USED WITH PERMISSION.

OIL SPILL VOLUNTEER? : WE NEED YOUR DATA!

The Deepwater Horizon oil spill has raised worldwide awareness of the critical roll of wildlife rehabilitators during environmental disasters. Hundreds of volunteers from our field are on site, and more will go, paying all expenses (and lost work time) out of their own pockets or those of their center without reimbursement. These costs are largely invisible to others. IWRC wants to ensure that state and federal agencies understand the *economic* value of rehabilitators in the Gulf Coast clean-up, and *we need your help*. It's simple. If you are a spill volunteer or a center who has sent staff, log your daily work-hours and all related expenses you can recall. Email your findings to IWRC at:

spillreport@theiwrc.org

You can do this daily, weekly, or once you return home--whatever is convenient (a daily log is most reliable). IWRC will compile results for use in increasing public and agency awareness of the full value of rehabilitation to wildlife conservation and management.

The US Fish & Wildlife Service provides information on the Deepwater Horizon Spill, with environmental updates and volunteer applications, at:

http://www.fws.gov/home/dhoilspill/index.html

wildlife into their personal possession. Complete restriction results in criminalizing a function that most people want done. A total lack of regulation results in random, well-meaning people making pets of wildlife that cannot be long-term domesticated, along with the injuries and zoonotic experiences that trained people know how to react to and prevent.

The 'trained people' invariably have to achieve this training on their own. The various 'DNRs' do not offer training or publications that are in any way internally directed or expected to allow a potential rehabilitator to achieve any level of DNR-recognized or accepted competence. I've yet to hear of a state that provided a single 'rehabber' with any of the supplies that the states require each 'permitted rehabber' to use, or any of the truly expensive food supplies that it takes to feed wildlife in the manner the states require. When the states aren't specific regarding food requirements, the self-trained 'rehabbers' are expected to be.

"The people of the state" of any state want and expect that the baby squirrel they found will be fed properly, housed properly, and will be released into the wild as soon as is reasonable. They, also, usually think there is someone in their state that attempts to be 'responsible' for that squirrel. That always falls totally upon the rehabber. Every day, each county of each state has from tens to hundreds of calls to various agencies trying to find out what to do with a wild animal they have found in distress. Some are found during house remodeling. Some when a tree comes down. Sometimes wildlife versus automobile traffic is the source of the call. If those people keep on trying long enough, they eventually get their state's DNR… who then tells them to call a local rehabber.

The DNRs, under no circumstances, take the animal into rehabilitation themselves. They do not perform that function, even when there are NO other options available.

When money is tight in state budgets, it is guaranteed that the constituents of that state have equally tight budgets. There is no reasonable way to suggest that 'finally charging for permits' will supply permit holders with anything whatsoever. To suggest that a permit holder will get some form of gratification or respect out of having PAID is simply self-serving to whoever is willing to do anything to found a new revenue stream. Does paying more get more respect? Will a really large fee get you extra recognition?

In the past week, I have been called upon to foster four baby squirrels, rescue an injured seagull, rehab an injured bat, and rescue–rehab an infant opossum. I've had at least another dozen calls in which I could assist a person with knowledge about some animal in a seeming predicament. All of the people that called me were referred to me by the DNR. The DNR is paying the person who refers me to do the job. I then have the job of driving all over the place to get these animals, feed them, house them, take them to veterinarians as needed, keep the records the DNR says I must keep, and then release them according to the state rules, which I also have to know. I get paid nothing, and it is quite expensive in time and money to do this. The idea that I should have to pay for the privilege of doing this appalls me. It is bad enough that I already have to pay for a federal permit to rehab birds. If the state decides to charge us as well, I, like many others, will simply drop from the rolls of licensed rehabbers. I suspect that many will do their rehabbing illegally. They will then be criminals. That is sad.

Russell D. Harper
Moraine Ridge Wildlife Rehabilitation Center
Chesterton, Indiana, USA

I don't see a tax on rehabbers as a solution to the problems I'm seeing here in New Mexico, unless it would be used to pay veterinarians or other appropriate authorities who could check on each of us. Wildlife rehabbers have fallen into a political morass similar to present business organizations—too much politics and too little concern for their clients—wildlife.

I would gladly support a tax that pays for the services of an honest, unbiased veterinarian; one who would examine all of our facilities regularly, check our reports, and follow up to make sure necessary changes have occurred. Nothing less will do.

Shirley Kendall
Raptor rehabilitator
Corrales, New Mexico, USA

IWRC presents new discussion topics in our member e-newsletter and encourages every member to respond to the questions. Replies may be edited for space and clarity.

Growth of Olive Ridley Turtles in Captivity with Two Different Diets

Natalia Corrales-Gómez, Guillermo Oro Marcos, and Ángel Herrera Ulloa

Introduction

Olive Ridleys (*Lepidochelys olivacea*) are globally distributed and are considered the most abundant of sea turtles (Zwinenberg 1976). Their preferred nesting areas occur along continental margins (National Marine Fisheries Service and U.S. Fish and Wildlife Service 1998). However, their populations have been declining during recent years (Spotila 2004) and they are considered a vulnerable species (International Union for Conservation of Nature [IUCN] 2008), largely due to overexploitation (Whitaker and Krum 1999). Several management techniques, which are part of recovery plans, have been employed to enhance recruitment into diminished populations. These techniques include taking newly hatched turtles into captivity and maintaining them for the period of time during which they are at a size where natural mortality factors that affect hatchlings can be minimized (Witham and Futch 1977; Caillouet *et al.* 1997; Bell *et al.* 2005). These management techniques allow the obtainment of important results, such as growth curves, for the conservation of wildlife populations (Witham and Futch 1977; Frazer and Ladner 1986; Boulon and Frazer 1990).



PHOTO © STACI PETERS. USED WITH PERMISSION.

Some rehabilitation centers have been created specifically to help sick or injured sea turtles and to reintroduce them back into the wild. The health programs required to treat captive sea turtles could be minimized through the development of proper husbandry practices and a sound preventive medicine program. Beyond this, the diet given to the animal is an important issue in captive management. An appropriate environment, and a program of medical care, is also essential to maintaining good health among captive sea turtles (Whitaker and Krum 1999).

Methods and Materials

The objective of our study was to compare the growth rates of two groups of posthatchling Olive Ridley sea turtles treated with two different diets; the turtles were from a nest in Puntarenas city (Central Pacific coast) in Costa Rica and were relocated to the Parque Marino del Pacifico rehabilitation center. Once they hatched, 12 individuals were kept in captivity and the others were released. The experiment started 1.5 mo after hatching. The individuals were kept in two separate, recirculating system tanks that were cleaned daily. The tanks were placed outdoors in order to receive direct sunlight. Group A (n = 6) was fed using a diet developed by the Parque Marino del Pacifico and group B (n = 6) was fed with a diet used in the Mote Marine Laboratory in Florida

IN YOUR PRACTICE: Increasingly, rehabilitators are being called upon to provide expertise for species recovery efforts, particularly in the area of captive husbandry. This paper compares the growth rates of sea turtle hatchlings raised on two different diets—one commercially available and one developed by a marine park in Costa Rica.

ABSTRACT: Some wildlife rehabilitation centers have been created specifically to help sick or injured sea turtles and to reintroduce them back into the wild. The diet given to the animal is an important issue in captive management. Our objective was to compare the growth rates of two groups of posthatchling Olive Ridley (*Lepidochelys olivacea*) sea turtles that were treated with two different diets; the turtles were from a nest in Puntarenas on the Central Pacific coast of Costa Rica. The group treated with a diet formulated by the rescue center presented higher growth rates than the group treated with an alternative diet. However, there was not a significant difference in the specific growth rate nor in the feed conversion rate. The study done at our center, "Parque Marino del Pacifico," showed that the center's diet, a controlled variety of seafood and a mixture of vegetables, constituted a good food supplement for these turtles, as revealed by the growth-rate results.

KEY WORDS: captivity, diet, growth, *Lepidochelys olivacea*, Olive Ridley, rehabilitation.

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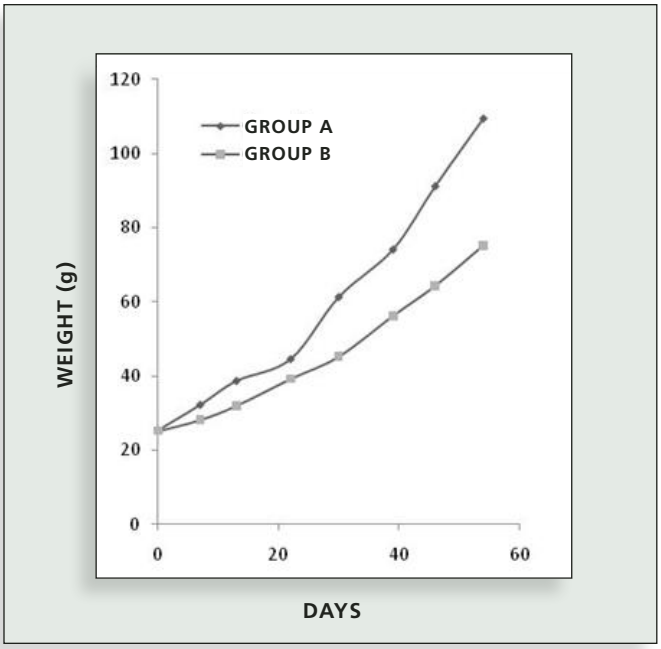


FIGURE 1. Weight of group A (diet from Parque Marino del Pacifico) and group B (alternative diet) during the study period.

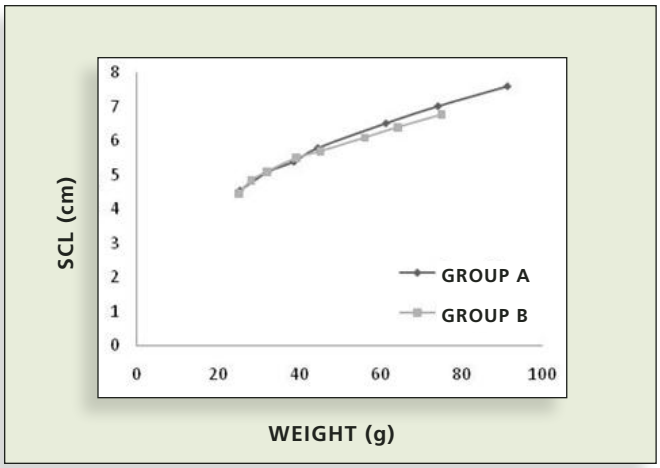


FIGURE 2. Regression analysis between weight and standard carapace length (SCL) in groups A and B.

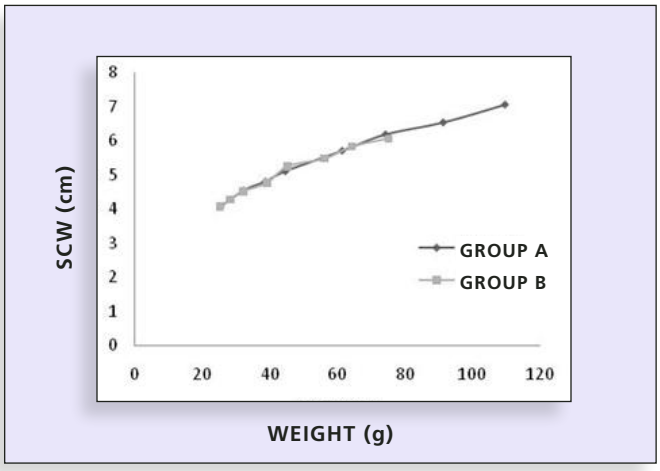


FIGURE 3. Regression analysis between weight and standard carapace width (SCW) in groups A and B.

(Table 1) which included commercial Tortoise pellet, Reptomin® from Tetra®, (Spectrum Brands Corporate, United Pet Group Inc., Cincinnati, Ohio, USA), high-protein level (29%) mostly fish meal. Both groups were fed *ad libitum,* four times a day, starting with an amount that was at least equivalent to 20% of body weight.

The study was done over a period of 48 days. Once each week, the turtles were weighed and the dimensions of standard carapace length (SCL) and standard carapace width (SCW) were measured with a caliper to the nearest 0.1 cm. An average of specific growth rate (SGR) for each group was calculated using the following equation:

$$SGR = [(\text{Ln } x_t - \text{Ln } x_0)/t]*100$$

where t = time elapsed among measurements, x_t = measurement at the end of the interval, and x_0 = measurement at the beginning of the interval.

Feed conversion rate (FCR), defined as the ratio of the gain in the "wet body weight" of the animal to the amount of feed fed, was also calculated in order to represent the mass of food eaten, divided by the mass gain, over the specific period of study. A regression analysis was used to determine the relationship between SCL and weight, as well as the relationship between SCW and weight.

A Mann–Whitney *U*-test (*U*) was used to compare the growth rate within the groups and to determine if there were differences in morphologic measures between the groups. To evaluate if there was a difference between the SGR and FCR of two groups, we applied a Chi-square (χ^2) test.

Two turtles from group A died during the first 2 wk, dropping the group from six to four. There were no indications that mortality was caused by diet problems. The data for the two hatchlings that expired were not used in the analysis.

Results

Group A exhibited a higher growth rate than did group B (Fig. 1), showing a significant difference ($U = 553.0$; $P = 0.035$) between weights of groups A and B. This was also reflected in morphologic measures. Group A was higher in SCL ($U = 508.5$; $P = 0.01$) and in SCW ($U = 524.0$; $P = 0.01$) than was group B. However, no significant difference in SGR and FCR were detected between the two groups. Group A showed an SGR of 3.2%, while group B showed an SGR of 2.2% ($\chi^2 = 0.16$, df = 1; $P > 0.05$); group A showed an FCR of 1.55, while group B showed 1.35. ($\chi^2 = 0.01$; df = 1; $P > 0.05$).

In group A, the lineal regression showed that the variation in weight explained 94.6% of the variation in SCL (Fig. 2). The regression also showed that weight explained 97.8% of the variation in SCW (Fig. 3). In group B, the same analysis showed that the variation in weight explained 97.0% of the variation in SCL (Fig. 2) and explained 97.2% of the variation in SCW (Fig. 3).

Discussion

Whitaker and Krum (1999) discussed that captive sea turtles require a balanced diet combining proteins, fats, moisture, carbohydrates, vitamins, and minerals. Analysis results from the diet formulated at Parque Marino del Pacifico showed that our center's diet, comprising a controlled variety of seafood and a mixture of vegetables, constituted a good food supplement for these turtles, as the growth-rate results revealed.

The water temperature is another aspect that can affect the growth rates of sea turtles (Mafucci *et al.* 2006). Growth rates in ectothermic species depend on the interactions of temperature and food availability. High temperatures during digestion increase the action of digestive enzymes, appetite, gastric contraction frequency, and amplitude (Jackson and Cooper 1981). The effects of these interactions in different conditions may directly affect an ectotherm's performance, survival, and reproduction. In this study, the sea turtles were housed in two separate tanks, with a closed circulating system and with stabilized environmental conditions. Therefore, water temperature was not a factor, and the differences in growth rates were directly related to the supplied diet.

The increase in the average SCL of both groups is higher than that reported by Rosales and Ramboux (1982) for the same species. The same finding also occurred with the data presented for juvenile green sea turtles (*Chelonia mydas*) (Bell *et al.* 2005) and for hawksbill turtles (*Eretmochelys imbricata*) (Gutierrez and Cabrera 1996). The increase in the average SCL of both groups in our study may be because of the smaller number of sea turtles used in our project. Fewer animals resulted in low densities within the controlled environment, thereby limiting aggressive behaviors such as those reported by Rosales and Ramboux (1982). Another important aspect was the feeding rate in our study: on average, the amount of food given was about 22% of the body rate, much higher than the 5% reported in other studies (Rosales and Ramboux 1982; Gutierrez and Cabrera 1996).

TABLE 1. Diets given to posthatchling sea turtles.
Group A = received diet from Parque Marino del Pacifico;
Group B = received alternative diet.

CONTENT	GROUP A %	GROUP B %
Fish	10.60	22.35
Squid	5.30	0
Shrimp	5.30	0
Spinach	2.80	2.61
Carrot	2.70	0
Water	53.00	52.14
Gelatin	8.50	8.38
Fish food	10.00	0
Reptomin®	0	11.17
Pecutrin®	1.80	3.35
Total	100.00	100.00

Conclusions

As a rehabilitation center, the main objective of Parque Marino del Pacifico is to rehabilitate injured or sick turtles, in the shortest time possible, and then place them back into the wild. Therefore, a good diet is a necessary factor in all rehabilitation programs intended to improve the health of sea turtles, a factor that supports the soonest-possible release.

Acknowledgments

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Incidence and Management of Live and Injured Bats at Wind Energy Facilities

Brandon J. Klug and Erin F. Baerwald

Introduction

Although concerns about the environmental impact of wind energy have historically considered bird fatalities, recent studies have shifted the focus to bats (Johnson *et al.* 2003, 2004, Kunz *et al.* 2007, Arnett *et al.* 2008). Relatively high numbers of bat fatalities have been reported at some wind energy facilities in various landscapes globally (Ahlén 2003, Johnson *et al.* 2003, Dürr and Bach 2004, Johnson 2005, Arnett *et al.* 2008). In North America, fatality rates vary across the continent, with reports of fatality rates as high as 63.9 bats per turbine per year (Fiedler *et al.* 2007). Primarily, three species of migratory, tree-roosting bats appear to be affected: hoary bats (*Lasiurus cinereus*), silver-haired bats (*Lasionycteris noctivagans*), and eastern red bats (*Lasiurus borealis*) (Johnson 2005, Arnett *et al.* 2008). The majority of these fatalities occur during fall migration (mid-July through September) (Arnett *et al.* 2008).



Hoary bat *(Lasiurus cinereus)*.

The published literature on post-construction fatality monitoring at wind energy facilities contains little information on the occurrence of live and injured bats. Between 2001 and 2004, in reports with documented live-bat occurrences, live-bat discovery rates varied between 0.6% (Arnett 2005) and 4.0% (Fiedler 2004). Discovery of live bats on the ground at wind turbines can be frequent; in 2004, researchers found 9 live bats within a 6-wk period at a single site (Arnett 2005). Currently, no published information or guidelines are available that specifically pertain to the documentation and management of live and injured bats found at wind energy facilities.

During our study on patterns and causes of bat fatalities at wind energy facilities, we found numerous live and injured bats. In this paper, we examine patterns of

IN YOUR PRACTICE: As wind energy becomes more prevalent, rehabilitators can expect to be called upon to provide assistance and expertise. This article provides useful information on which species are commonly impacted by wind turbines, the types of injuries sustained, and possible treatment protocols.

ABSTRACT: Little information exists about finding and managing live bats injured at wind turbines. Our study examines field methods for finding, and successfully treating and releasing, bats and humanely euthanizing those that are terminally injured. Our discovery rate of live and injured bats was greater at turbines searched daily than at turbines searched weekly, and immediate in-field rehydration proved essential in successful treatment. This information can be used to assist in mitigating bat fatalities at wind energy facilities through the timely discovery, treatment, and release of live bats.

KEY WORDS: bats, fatalities, injuries, live and injured bats, *Lasiurus cinereus, Lasionycteris noctivagans*, wildlife rehabilitation, wind turbines

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live-bat occurrences at our study site and suggest methods for conducting searches at wind energy facilities to increase the likelihood of finding live bats. We also discuss field methods used to evaluate and manage live and injured bats for successful release or humane euthanization. Traumas sustained by bats from encounters with wind turbines are potentially unique and complex (e.g., Baerwald *et al*. 2008), and seriously injured bats should be euthanized. Several methods exist to euthanize a bat and we discuss those we employed in the field.



PHOTO © FABRICE SCHMITT. USED WITH PERMISSION.

Eastern red bat (*Laziurus borealis*).



PHOTO © KEVIN SMITH. USED WITH PERMISSION.

Silver-haired bat (*Lasionycteris noctivagans*).

Methods

We conducted our study at three wind energy facilities in south-western Alberta, Canada in 2006 and 2007. All three facilities were in mixed agricultural and native grasslands. Two sites contained turbines with 80-m diameter rotors on 65-m monopole towers (n = 39 and n = 2 turbines, respectively). The third site consisted of a single turbine with a 90-m diameter rotor on a 67-m monopole tower. We conducted carcass searches at 40 turbines from 15 July through 30 September 2006 and at 42 turbines from 15 July through 30 September 2007. Of the 42 turbines, we searched 32 turbines once a week and 10 turbines daily. To search the turbines, one searcher held the end of a 45-m rope attached to the base of the turbine and another searcher held the end of a 7-m rope attached to the first searcher. Starting with the ropes fully extended (i.e., to 52 m from the turbine base), both searchers walked in a spiral around the base of the turbine. The rope lost 14 m of length with each rotation (i.e., the circumference of the turbine tower), thereby creating transects 7 m apart (see Baerwald 2008).

When we found a live bat, we immediately immobilized it and transported it to our vehicle for assessment and treatment. We examined bats for obvious physical trauma such as hemorrhaging, broken or severed wings, and open lacerations. We made a subjective decision to treat or euthanize bats depending on the severity of the injuries present. Injuries rendering a bat suitable for euthanization included wing amputations, compound fractures, fractures occurring too close to a joint to allow for stabilization, open lacerations, abdominal evisceration, and spinal fractures. We promptly euthanized bats meeting these criteria by way of cervical dislocation or an overdose administration of inhalant anesthetic (isoflurane; Halocarbon Products Corporation, River Edge, New Jersey, USA). For the latter method, we followed the procedures outlined by Lollar and Schmidt-French (2002).

We immediately rehydrated all bats considered suitable for treatment. In 2006, we provided drinking water orally via an eyedropper. In 2007, we initially delivered a mass-specific amount of lactated Ringer's solution (LRS) via subcutaneous injection as per Lollar and Schmidt-French (2002) and then offered a 50% Pedialyte® (Abbott Nutrition, Columbus, Ohio, USA) solution orally. After immediate rehydration, we placed bats in small cloth bags, out of direct sunlight and in a cool location, with adequate ventilation. On hot days (≥25°C), we placed the bags in an open cooler containing an ice pack wrapped in cloth. We took caution not to place the holding bags directly on the ice pack. Every 2 hr following our initial assessment, we checked the condition of the bats and delivered fluids accordingly; we offered water orally if bats showed signs of improvement and repeated the delivery of LRS subcutaneously if signs of dehydration and unresponsiveness persisted.

We followed this schedule of treatment until we could return to our field station.

We re-examined the condition of bats at our field station. We noted injuries not previously detected and documented the incoming mass of each bat. We continued fluid replacement therapy and provided water freely to those showing signs of improvement and the ability to accept water orally (in 2006 and 2007), or delivered further treatments of subcutaneous rehydration, using LRS, if signs of dehydration persisted (in 2007). We then transferred the bats to larger, more-permanent enclosures if their condition permitted; bats with minor skeletal injuries, such as bruised joints, remained in the cloth bags to reduce mobility and the risk of further injury. Bats remained at the field station in seclusion where we continued to monitor their condition until release.

We handled all bats in accordance with protocols approved by the Canadian Council on Animal Care and the University of Calgary Animal Care Committee, as well as in accordance with research permits granted by the Fish and Wildlife Division of Alberta Sustainable Resource Development. All personnel involved in our research were given rabies pre-exposure prophylaxis. In an effort to reduce stress on the animal, we completed all assessments, treatments, and measurements quickly (usually within 5 min) and with minimal disturbance to the bat. We used information provided by Lollar and Schmidt-French (2002), as well as by the National Wildlife Rehabilitators Association and International Wildlife Rehabilitation Council (Miller 2000), to determine diet and feeding schedules and to ensure that housing was adequate for all bats in our care. In dealing with minor injuries, we continued to follow protocols laid out by Lollar and Schmidt-French (2002). We took bats that were ready for release to a site close to our study area and released them shortly after sunset, in pairs if possible.

Results

We encountered 1,033 bats during the two years of our study. Of those, we found 26 (2.5%) alive (Table 1). We found significantly more live bats at turbines searched daily ($n = 16$) than at turbines searched weekly ($n = 8$) (Fisher's Exact test, $P = 0.008$). Our discovery rate of live bats was significantly greater at daily

TABLE 1. Date, species, injuries sustained, and fate of each of the 26 live bats found during studies at wind energy facilities in southern Alberta in 2006 and 2007.

DATE	SPECIES	OBSERVED INJURIES	FATE
2 Aug 06	*Lasiurus cinereus*	None	Flew away
6 Aug 06	*L. cinereus*	None	Treated, released 4 days later
11 Aug 06	*L. cinereus*	Both femurs fractured, elbow laceration	Treatment attempted, died in care 3 wk later
13 Aug 06	*Lasionycteris noctivagans*	None	Treated, released 3 days later
13 Aug 06	*L. noctivagans*	Compound wing fracture	Euthanized (cervical dislocation)
13 Aug 06	*L.noctivagans*	Compound wing fracture	Euthanized (cervical dislocation)
14 Aug 06	*L. noctivagans*	None	Died on site, cause unknown
17 Aug 06	*L. cinereus*	None	Treated, released 2 days later
24 Aug 06	*L. cinereus*	Compound wing fracture	Euthanized (cervical dislocation)
29 Aug 06	*L. cinereus*	None	Treated, released 3 days later
30 Aug 06	*L. noctivagans*	Wrist bruised	Treated, released 3 days later
9 Sep 06	*L. noctivagans*	None	Treated, released 2 days later
6 Aug 07	*Myotis lucifugus*	None	Died on site, cause unknown
12 Aug 07	*M. lucifugus*	None	Treated, released 2 days later
13 Aug 07	*L. cinereus*	Compound wing fracture	Euthanized (isoflurane)
15 Aug 07	*L. cinereus*	Amputated wing	Euthanized (isoflurane)
17 Aug 07	*L. cinereus*	Compound wing fracture	Euthanized (isoflurane)
24 Aug 07	*L. noctivagans*	None	Treated, released 5 days later
25 Aug 07	*L. noctivagans*	None	Treated, released 4 days later
29 Aug 07	*L. noctivagans*	None	Treated, released 5 days later
29 Aug 07	*L. cinereus*	Elbow severely bruised	Treatment attempted, died in care 2 mo later, cause unknown
31 Aug 07	*L. noctivagans*	None	Treated, released 3 days later
3 Sep 07	*L. noctivagans*	None	Died on site, confirmed barotrauma
5 Sep 07	*L. noctivagans*	Fractured phalanges	Treatment attempted, died in care 6 days later, cause unknown
8 Sep 07	*L. noctivagans*	None	Treated, released at start of following season
10 Sep 07	*L. noctivagans*	None	Treated, released at start of following season

(4.0% of 400 total bat discoveries at turbines checked daily) than at weekly (1.2% of 633 total bat discoveries at turbines checked weekly) (χ^2_1 = 7.98, P = 0.005). Outside our regular search effort, we found two live bats while driving past turbines not scheduled for search that day. We found the majority (n = 22) of live bats within 35 m of the turbine base (mean = 21.1 ± 2.8 m); this equates to 84.6% of live bats found within less than half (45.3%) of the total search area. Two species of migratory bats comprised 92.3% of the live bats we found—14 silver-haired bats (53.8%) and 10 hoary bats (38.5%). The remaining two bats were local, nonmigratory little brown bats (*Myotis lucifugus*).

Only eight (30.8%) of the live bats we found had visible signs of skeletal damage or considerable soft tissue trauma. We observed one or more of the following injuries: wing fractures (n = 7), wing amputation (n = 1), leg fractures (n = 1), and open abdominal wounds (n = 1). Although not statistically significant (Fisher's Exact test, P = 0.211), the rate of obvious external injury was higher in hoary bats (50.0%) than in silver-haired bats (21.4%). We did not observe any such external injuries in the two little brown bats. We euthanized three bats by cervical dislocation in 2006 and three bats by administration of isoflurane in 2007. Of the 18 bats with no obvious sign of injury, three died on-site due to undetectable injuries or complications. One of these bats, a silver-haired bat, had blood in the nose and mouth; histological examination at the University of Calgary showed rupture of nearly all alveoli in both lungs (Baerwald *et al*. 2008), symptoms consistent with barotrauma.

We attempted to treat 16 of the 26 live bats we found. All of the live and injured bats we assessed showed minor to severe signs of dehydration such as papery wings, lethargy, and wrinkly skin (Lollar and Schmidt-French 2002). Upon both oral and subcutaneous rehydration, bats showed improvement in alertness and activity levels. However, subcutaneous injection of fluids resulted in faster recovery times; signs of dehydration typically decreased within 30 min of subcutaneous rehydration therapy, compared to the several hours that was typical of oral rehydration. It was uncommon (n = 2) for a bat to require multiple injections of LRS before regaining the ability to drink. Complete recovery time ranged from 2 to 5 days, the exception being two silver-haired bats found late in the season (mid-September) during inclement weather and released the following May (Table 1). We successfully released 13 (81.3%) of the bats we attempted to treat, the majority (n = 11) of which were released within 5 days and required only rehydration therapy for recovery.

Discussion

It is not certain how long an injured bat can remain alive after being grounded by a wind turbine, but many factors, including dehydration and predation by birds, mammals, and insects, imply that the time frame is as little as 1 day. This study suggests that searching turbines daily results in the discovery of more live bats than does searching each turbine once per week. We found two bats by driving by turbines not scheduled to be searched that day, which suggests that in areas where ground vegetation is low (e.g., harvested cropland), live bats can be found simply by having a daily presence on the site, driving slowly, and making an effort to look for them. Given that the majority of live bats we found were within 35 m of a turbine base, to increase the chance of finding live bats we suggest extending any search transects to at least that distance. If resources are limited, and discovery of live bats is a priority, then searchers could limit their searches to encompass this 35-m radius. However, this distance may vary depending on turbine height and rotor diameter.

Assessment of a live bat—and the decision to treat or euthanize it—remains largely subjective. We chose to euthanize any bat with injuries that would severely impede its ability to fly or forage successfully, or diminish the bat's quality of life. Due to our limited resources in the field and our inability to handle traumas in a sterile environment, our criteria for euthanization were broad. However, bats with wing fractures can be successfully rehabilitated and released in other situations with adequate resources (Hofstede *et al*. 2003). In the first year of this study, the discovery of live bats was unexpected and, thus, we were unequipped to deal with euthanization by any means other than cervical dislocation. This and other methods of nonchemical euthanization are discouraged because they have relatively high failure rates and induce undue pain and stress on the bat; even cervical dislocation can cause pain and delayed effects in some instances (Lollar and Schmidt-French 2002). Consequently, in 2007, we used an excessive dose of isoflurane to induce humane death (Lollar and Schmidt-French 2002). This method is preferred and recommended, as it is easy to carry out, results in no excess stress on the bat, and does not use a controlled substance (such as pentobarbital sodium; MTC Pharmaceuticals, Mississauga, Ontario, Canada) which may be difficult for some researchers to obtain.

Dehydration appeared to be the immediate threat to survival for bats without severe injuries. In most cases, bats that are unable to fly due to injury or illness require rehydration (Lollar and Schmidt-French 2002). At our study area, ambient temperatures reached in excess of 30°C during the months of peak migration (mid-July through mid-September). Dehydration can be exacerbated when crops are harvested and bats are subjected to direct sunlight. We found prompt rehydration and cooling to be crucial in the treatment of injured bats. Most of the live bats we encountered showed little sign of injury and required nothing more than rehydration therapy to recover. In 2007, we implemented subcutaneous rehydration as the initial means to deliver fluids, and this method proved to be faster, easier, and more reliable than oral rehydration. Attempts to rehydrate a bat orally, one that is unable to drink on its own, can result in failure and the risk of drowning if forced or done improperly; these procedural issues are avoided with subcutaneous rehydration therapy. However, we realize most

personnel conducting fatality surveys lack the proper training and experience to perform such a task. Therefore, we feel oral rehydration remains an adequate, safe method for the delivery of fluids to a dehydrated bat—if properly done.

There were cases in which a bat was seemingly uninjured but still died. Internal injury can be difficult to identify, and treat appropriately, in the field. The extent of blunt-force trauma in bats resulting from collisions with turbine blades remains unknown. To complicate the situation further, barotrauma is a significant cause of bat fatalities at wind energy facilities (Baerwald *et al*. 2008). Gasping, inability to breathe, blood in the airway, and lethargy are indicative of barotrauma, but are difficult to assess and pinpoint (when induced by barotrauma) without histological examination; in many cases, injured bats show no clinical sign of barotrauma. Nearly half the bat carcasses discovered in our study had no fatal external injuries, but over 90% of those necropsied had internal injuries consistent with barotrauma (Baerwald *et al.* 2008). Such internal injury may go unnoticed and, consequently, the bat may die unexpectedly. This was evidenced in the necropsied silver-haired bat that died before showing any signs of injury and was later found to have extensive tissue damage in the lungs. To date, treatment of this type of decompression trauma in bats has not been addressed.

The impact of turbine-related mortality on bat populations is unknown, but has the potential to be considerable. Bats have unique life histories relative to other mammals of similar size. They reproduce slowly, bearing one or two pups a year depending on the species, and can live over 30 years in the wild (Barclay and Harder 2003). This slow life history makes bat populations susceptible to novel causes of mortality. Little knowledge exists about population sizes of migratory bats, or about the proportion of bats killed while migrating through wind energy facilities. Assessments have reported migratory-bat fatalities in the hundreds to the thousands at some sites in North America (Arnett *et al.* 2008). As the wind energy industry continues to grow (American Wind Energy Association 2008, Canadian Wind Energy Association 2008), and bat fatality monitoring becomes more common, we can expect more discoveries of live and injured bats at wind turbines.

For personnel conducting fatality surveys, it may be necessary to obtain permits for handling live wildlife as well as carcasses. Our research, including the handling and treatment of live bats, was authorized by the Fish and Wildlife Division of Alberta Sustainable Resource Development. To our knowledge, the legal issues surrounding the handling of live wildlife have not been addressed during other industry-led fatality surveys because discovery of live animals was not expected. The risk of exposure to rabies should also be addressed; all personnel expected to handle live bats should receive rabies pre-exposure prophylaxis, and those expected to handle only bat carcasses should wear gloves at all times. Under no circumstances should treatment of live and injured bats be attempted by the general public.

Our experiences suggest that live and injured bats can be properly managed if personnel involved in fatality surveys at wind energy facilities are authorized to handle live bats and are prepared to rehydrate suitable individuals and euthanize those with terminal injuries. In regions where bat rehabilitation is legal, and the facilities are available, the potential to rescue and release a substantial number of bats exists. Kunz *et al.* (2007) projected that the annual bat fatalities in the mid-Atlantic Highlands in 2020 could be between 33,000 and 111,000. If our live-bat discovery rate of 2.5% holds true, then 825 to 2,775 live bats could be found. If our treatment success rate of 50% is achieved, then 413 to 1,388 bats per year could be treated and released in this region. Since cumulative impacts of turbine-related fatalities on bat populations are unknown, it is important to implement a variety of mitigation strategies, including those aimed at treating and releasing suitable live and injured bats. However, given that conducting daily carcass searches and effectively treating bats may be costly, such efforts should be complimentary to other mitigation strategies at high bat-fatality sites. Primary efforts should remain focused on operational strategies, such as low wind-speed shut downs, which have been successful in significantly decreasing bat fatalities (Baerwald *et al*. 2009).

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Cause of Admittance in Raptors Treated at the Illinois Raptor Center, 1995–2006

Mallory R. Neese, Jane Seitz, Jacques Nuzzo, and David Joseph Horn

Introduction

Currently, human causes of avian morbidity and mortality are increasing—and superseding those caused by natural factors (Fix and Barrows 1990, Deem *et al*. 1998). From 500 million to over 1 billion birds are killed by human causes in the United States each year (Erickson *et al*. 2005). Mortalities come from collisions with vehicles, power lines, communication towers, wind turbines, and windows; electrocution; poisoning; and cat predation (Erickson *et al*. 2005). Urbanization and agricultural intensification alter habitat and produce new environmental challenges for groups of birds such as raptors (Boal and Mannan 1999).

How raptor species are influenced by human activity, and the raptors' subsequent species-specific behaviors, may influence cause of injury. For instance, raptors adapted to urban environments experience greater numbers of attacks by cats and dogs, whereas raptors using power lines as perches are more susceptible to electrocution (Harden 2002, Erickson *et al*. 2005). Raptors hunting in residential areas have a higher proportion of window collisions (Boal and Mannan 1999), and species hunting near roadsides are injured more frequently by vehicle collisions (Massemin and Zorn 1998).

Cause of admission also changes over the course of the year. Wendell *et al*. (2002) examined raptor admissions at the Colorado State University Veterinary Teaching Hospital and found that trauma was the most common cause of morbidity and mortality overall; however, the most frequent reason for admission changed throughout the year. Between March and August, orphaned raptors represented the largest number of admissions. Between September and November, most raptors were admitted with unknown or unspecified injuries, while between December and February, toxicosis was most common.

We studied raptor rehabilitations recorded at the Illinois Raptor Center (IRC) in Decatur, Illinois, USA between 1995 and 2006, to assess causes of admission in central Illinois raptors, and to determine how causes of admission change over the course of the year. By learning more about the frequency of admissions and how raptor behavior influences susceptibility, we can develop solutions to reduce the amount of morbidity and mortality.

Methods

The IRC is a wildlife rehabilitation and educational facility in Decatur, Illinois, USA. The IRC admits raptors on a case-by-case basis, by appointment, and occasionally admits birds from other rehabilitation centers and from the University of Illinois Wildlife Medical Clinic. Information on each raptor is collected including date, species, injury or reason for admission, and the city and county where the raptor was found. The data are compiled annually into a wildlife report and submitted to the Illinois Department of Natural Resources and US Fish and Wildlife Service. The wildlife report data collected by the IRC from 1995–2006 were examined in this study.

Reasons for admission were divided into 35 categories, based on the raw data taken from the IRC wildlife reports (Table 1). If a raptor had two listed causes of admission, the most severe cause was used. Chi-square (χ^2) tests were performed for specific admissions that occurred ≥20 times between 1995–2006, both to examine if the frequency of a particular admission was equivalent among species and if specific admissions occur evenly

IN YOUR PRACTICE: Rehabilitators regularly collect patient histories at intake, but these data are rarely used in research applications. This paper provides one example of the value of examining rehabilitation data over a 12-year period: to identify trends that may provide insight for future conservation and impact-mitigation efforts.

ABSTRACT: Raptors are threatened by both anthropogenic and natural factors. We examined the cause of admittance and their temporal occurrence in raptors admitted to the Illinois Raptor Center in Decatur, Illinois, United States from 1995–2006. Six species were analyzed: Cooper's hawk *(Accipiter cooperii)*, red-tailed hawk *(Buteo jamaicensis)*, American kestrel *(Falco sparverius)*, eastern screech-owl *(Otus asio)*, great horned owl *(Bubo virginianus)*, and barred owl *(Strix varia)*. Each raptor species was prone to a different suite of admission causes. Sixty-five percent of raptors involved in window collisions were Cooper's hawks, and 61% of raptors involved in vehicle collisions were great horned owls and barred owls. By recognizing patterns of raptor admissions, we can develop solutions to reduce the morbidity and mortality associated with these admissions.

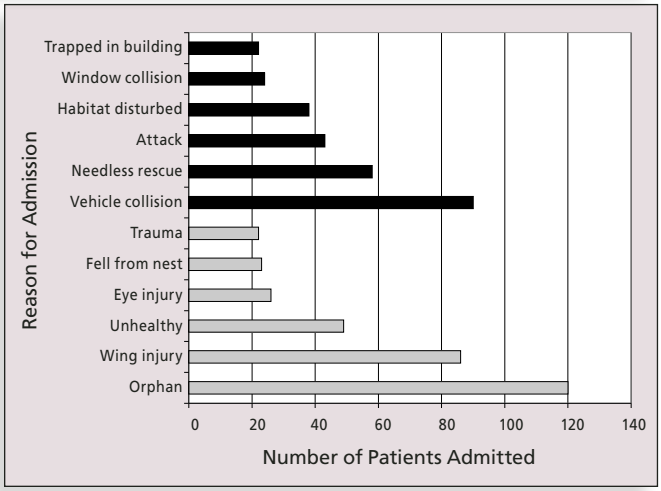
KEY WORDS: Admission, behavior, collision, hawk, Illinois Raptor Center, injury, kestrel, orphan, owl, raptor, rescue, trapped

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TABLE 1. Categories of admittance of raptors treated at the Illinois Raptor Center in Decatur, Illinois, United States from 1995–2006.

INJURY TYPE AND EXAMPLES	NO. REPORTED
Attack by cat, crow, dog, human	43
Beak injury such as broken beak	3
Broken back	1
Bumble foot	1
Caught in items such as string, fishing line, hunting trap	7
Dead on arrival	8
Deformed	2
Electrocution	7
Eye injury including blind eye, blood in eyes	26
Falconry bird recovered	1
Fell from nest	23
Fledgling, juvenile that cannot care for itself	19
Found displaced such as on the road, out of nest	14
Fracture (unspecified location)	3
Gun shot	7
Habitat disturbed and knocked out of nest	38
Human interference including illegal pet, imprint, intentionally cut feathers, removed from danger	13
Imping necessary	3
Keel injury	1
Leg injury such as fractured leg	7
Mobbed	3
Needless rescue	58
Nuisance	4
Oil	2
Orphan	120
Poisoned	4
Trapped in a building	22
Trauma	22
Unable to fly	18
Unhealthy such as sickly, starving	49
Unknown admission including rehabilitation, unspecified injury, other	244
Vehicle collision such as car, train	90
West Nile Virus (suspected cases)	13
Window collision	24
Wing injury such as broken wing, bruised wing, wing amputee, wing torn off	86



throughout the year. Additional χ^2 tests were also performed to determine if the numbers of each species of raptor admitted to the IRC was equivalent each month. For analyses involving individual species, only species with ≥20 admissions to the IRC between 1995–2006 were used. When expected frequencies of χ^2 tests were equal, but below 5, significance levels below the standard 5% (i.e., $P < 0.05$) were necessary for results to be considered conservative (Zar 1984). Therefore, we considered results of all statistical tests to be significant if $P < 0.01$.

Results

From 1995–2006, the IRC treated 986 raptors of 21 species; these comprised most of the eagle, hawk, falcon, and owl species found in central Illinois. The number of raptors admitted ranged from 50 in 2003 to 140 in 1999, with a mean of 82. Six species were admitted ≥20 times to the IRC, Cooper's hawk ($n = 57$), red-tailed hawk ($n = 163$), American kestrel ($n = 268$), eastern screech-owl ($n = 165$), great horned owl ($n = 191$), and barred owl ($n = 85$), and accounted for 94% of the raptors admitted to the center.

The 986 raptors admitted to the IRC between 1995–2006 were admitted for a number of causes (Table 1). Twenty-five percent of raptors (244) fell into 'unknown admission' including rehabilitation, unspecified injury, or other. The remaining 75% of raptors (742) fell into 34 categories, ranging from 1 to 120 events, with a mean of 22. Of the twelve admission categories for which ≥20 events were reported, 55% (329) were suspected to be from natural or unidentifiable causes while the other 45% (272) were human caused (Fig. 1). We found that the proportion of needless rescues ($P = 0.0025$), orphans ($P = 0.0005$), trappings ($P = 0.001$), vehicle collisions ($P < 0.0001$), window collisions ($P < 0.0001$), and wing injuries ($P = 0.0002$) differed among species (Table 2).

The cumulative number of raptors admitted between 1995–2006 varies per month with January having 50 admissions, February = 43, March = 51, April = 102, May = 165, June = 201, July = 91, August = 72, September = 55, October = 49, November = 60, and December = 47. Cooper's hawk ($P = 0.41$) and red-tailed hawk ($P = 0.89$) had no difference in the month that admittance occurred, while American kestrels ($P < 0.0001$) peaked in June. Eastern screech-owl ($P < 0.0001$), great horned owl ($P < 0.0001$), and barred owl ($P = 0.0091$) all exhibited differences in monthly admittance. Eastern screech-owls peaked in May and great horned owls in April, while barred owls peaked during April and May.

Admittance of all species, combined, were more likely to occur during specific months of the year, e.g., as a result of habitat disturbances ($P = 0.0001$), needless rescues ($P < 0.0001$), orphans (P

FIGURE 1. The twelve, most-common causes of admittance of central Illinois, USA raptors treated at the Illinois Raptor Center between 1995–2006. These data omit those causes with fewer than 20 incidents. The first six admission categories listed from top to bottom are associated with human causes (45% of total), and the remaining six are natural causes or have an unidentified origin (55%).

TABLE 2. Reasons for admission were species-specific at the Illinois Raptor Center (IRC) in Decatur, Illinois, USA from 1995–2006.

CAUSE OF ADMITTANCE	AMERICAN KESTREL	COOPER'S HAWK	RED-TAILED HAWK	BARRED OWL	EASTERN SCREECH-OWL	GREAT HORNED OWL
Needless rescues	49%1 (102)	0% (0)	9% (3)	2% (1)	26% (9)	14% (4)
Orphans	39% (17)	2% (4)	7% (5)	3% (5)	26% (19)	22% (14)
Trapped in building	85% (6)	0% (0)	0% (0)	0% (0)	10% (1)	5% (1)
Vehicle collisions	12% (3)	1% (2)	12% (6)	36% (33)	14% (7)	25% (10)
Window collisions	22% (2)	65% (26)	0% (0)	0% (0)	13% (2)	0% (0)
Wing injuries	19% (5)	17% (21)	30% (13)	9% (7)	10% (4)	15% (5)

[1] Percentage of admissions by given raptor species (e.g., 49% of all needless rescues at the IRC involved American kestrel).

[2] Frequency of admittance into IRC for treatment by given raptor species (e.g., 10% of all American kestrel admissions were due to needless rescue).

< 0.0001), trappings ($P < 0.0002$), and wing injuries ($P = 0.0008$). For all species combined, habitat disturbances peaked in May and needless rescues and orphanings occurred more frequently April to July, whereas wing injuries peaked in March and May. No peak month for trappings was observed.

Discussion

Raptors admitted to the IRC were treated as a result of both natural and anthropogenic causes. Wildlife Rescue, Inc. of New Mexico, between 1994 and 1998, categorized 22% of injuries as natural, and 78% of injuries as anthropogenic, out of 2,157 admissions (Harden 2002). Deem *et al.* (1998) found 87% of 279 trauma cases in raptors were directly associated with human involvement. In admissions we were able to categorize, we found a substantial impact of human activity on central Illinois raptors, with at least 45% of admissions identifiable as human-caused.

Each species' tolerance to human activity, and that specie's subsequent reactive behavior, influences the type of injuries they sustain. The feeding ecology of Cooper's hawks may be contributing to window collisions as the most common admission of Cooper's hawks, accounting for 26% of all admissions in this species observed at the IRC. Boal and Mannan (1999) found that window collisions caused the greatest rate of mortality in Cooper's hawks in Tucson, Arizona (70%). They attribute this to backyard bird feeders drawing Cooper's hawks toward prey and windows.

Red-tailed hawks accounted for 30% of all wing injuries to the IRC, and wing injuries were the third, most-common reason for their admission. Further investigation into the cause of these wing injuries needs to be made, but we suspect they are due to collisions with human structures. For example, red-tailed hawks are more likely to kite in high wind conditions, making them more susceptible to collisions with wind turbines (Hoover and Morrison 2005).

American kestrels and eastern screech-owls are more susceptible to being brought in as orphans and to suffer needless rescues. Wendell *et al.* (2002) studied morbidity and mortality in raptors and found that 34% of both species of screech-owls, *Otus asio* and *Otus kennicotti*, came in as orphans to the Colorado State University Veterinary Teaching Hospital between 1995 and 1998. Due to their small size, kestrels and screech-owls may also be more susceptible to needless rescues, as they are mistakenly identified as being in danger, displaced, or orphaned (J. Seitz and J. Nuzzo, pers. obs.). In addition, American kestrels are more likely to get trapped in buildings. Buildings where kestrels get trapped typically have large garage doors or loading areas and contain large numbers of house sparrows (*Passer domesticus*) (J. Seitz, pers. obs.).

Great horned owls and barred owls are susceptible to collisions with vehicles, and 61% of all collisions with vehicles involve great horned owls and barred owls. Massemin and Zorn (1998) found that of 187 road-killed raptors in northeastern France, 173 were owls. Loos and Kerlinger (1993) found that 94% of avian–vehicle collisions in New Jersey, United States, were owls. The greater numbers of vehicle collisions among owls may be due to their hunting methods and to embanked highways, where owls usually fly 2–5 m above the ground, making them targets for vehicles (Massemin and Zorn 1998, Harden 2002).

Admittance to raptor centers corresponds with the life-history stages of raptor species. The IRC admits the majority of raptors during April, May, and June, where the most common identifiable cause of admission, orphans, frequently occurs. American kestrels peak at the IRC in June. According to Smallwood and Bird (2002), in Iowa, United States, kestrel pairs begin clutch initiation in April, incubation lasts for 27–29 days, and fledging occurs 28–31 days after hatching, meaning that a large majority of orphans would be found near May and juveniles would be dispersing near June. Great horned owl admissions peak at the IRC in April. For this species, clutching begins between January and February, with incubation an average of 33 days, and young fledge 6 wk later (Houston *et al.* 1998). Therefore, March and April would be the expected months where admissions of orphans are high, and April would be the month when fledglings are moving about, resulting in an increased incidence of admittance.

By understanding how species-specific behavior influences admissions, and when specific admissions are most likely to occur, we can develop solutions to reduce these factors of morbidity

and mortality. For example, Klem *et al.* (2004) found that moving bird feeders to within 1 m (~3 ft.) of a window reduced the number of fatal window collisions by songbirds. Future studies need to be conducted to determine if this preventative measure for songbirds would also reduce the number of injuries Cooper's hawks sustain at windows. Great horned owl and barred owl are more susceptible to vehicle collisions. Owl species may be drawn to roadsides by increased prey abundance in prairie grasses (Massemin and Zorn 1998). As more and more states adopt programs to restore roadsides with native prairie, owls may be increasingly susceptible to collisions. Thus, studies that examine how to reduce owl–vehicle collisions should be conducted and recommendations implemented when feasible. Furthermore, educational programs at rehabilitation centers could be timed to correspond with when particular injuries are more likely to occur (e.g., programs on unnecessary rescue of wildlife would be most effective in spring and summer).

Rehabilitation centers are valuable for advancing medical treatment, learning more about emerging diseases, understanding the human impact on wildlife populations, and as educational outlets to raise awareness of raptors (Fix and Barrows 1990, Sleeman and Clark 2003). Data from separate rehabilitation centers could also be combined. This would allow a better understanding of the causes of morbidity and mortality among raptor species and would promote the development of more-effective management strategies for reducing these causes.

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Successful Forelimb Amputation Procedure on a Sambar Deer (*Cervus unicolor niger*)

K. Singh, A. Kumar, S. K. Mahajan, and N. S. Saini

Introduction

The "survival of the fittest" is the law of nature. The musculoskeletal injuries of the appendages commonly encountered in wild cervids make them an easy prey to predators, or they may succumb to ascending infection. Limb amputation is a surgical procedure to remove a diseased or injured limb. Limb amputation is a salvage procedure for open, infected, and complicated fractures and is widely practiced in cats, dogs, and human beings; however, the literature is scanty concerning limb amputation in wild cervids. Amputation may be a life-saving procedure for the animals, a procedure that can minimally impact their comfort and quality of life (Crawley *et al.* 1989). The literature does cite limb amputation as a viable alternative to euthanasia in wapiti (*Cervus elephous*) (Quessada 1993; Butt *et al*. 2001). Long-term follow-up subsequent to such salvage procedures helps us to appreciate wild cervids' adaptability to surviving the catastrophic outcomes of limb loss.



PHOTO © LOUISE MORGAN. USED WITH PERMISSION.

Sambar deer (*Cervus unicolor niger*) are wild ruminants of the order Artiodactyla, family Cervidae, and subfamily Cervinae. It is the largest Indian deer and is listed under schedule III of the Indian Wildlife Protection Act. Rehabilitation of such animals is important for their conservation. The present report describes the successful rehabilitation of a sambar deer following its forelimb amputation. The general anesthesia protocol, monitoring, and blood-gas parameters are discussed.

Case report

A young, male, adult sambar deer, weighing about 200 kg and having an open, severely infected right metacarpal fracture, was presented at the Veterinary Teaching Hospital,

IN YOUR PRACTICE: The goal of returning an animal to life in the wild is not always attainable. When the species or individual animal is well suited to life in captivity, treatment protocols not commonly used may be considered. Limb amputation, widely used in companion animal practice, may be an alternative for some cervids as well.

ABSTRACT: Forelimb amputation from the middle third of the humerus was done under xylazine, ketamine, and thiopental-sodium general anesthesia in a young, adult sambar deer *(Cervus unicolor niger)* that presented with an open, severely infected right metacarpal fracture. The xylazine–ketamine–thiopental anesthesia is an alternate combination for surgery in deer that does not cause any significant blood gas and electrolyte changes. The animal recovered without any problem and rehabilitated at M. C. Zoological Park, Chat Bir, Patiala, India. On long-term follow-up over a period of 10 months, the animal was confirmed to be able to walk and run.

KEY WORDS: cervids, general anesthesia, limb amputation, metacarpal fracture, musculo-skeletal injuries, rehabilitation, sambar deer, wild ruminant.

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TABLE 1. Blood electrolyte and gas parameters changes at different time intervals.

PARAMETERS	INTERVALS (MIN)			
	0 MIN	15 MIN	30 MIN	105 MIN
Hb (g/dL)	7.4	5.0	4.7	4.4
PCV (%)	23.0	21.0	20.0	19.0
pH	7.4	7.4	7.4	7.4
CO2 mmHg	45.0	53.0	55.0	53.0
PO2 mmHg	37.0	35.0	35.0	37.0
K+ mmol/L	4.4	4.2	4.5	4.5
Cl– mmol/L	102.0	101.0	101.0	101.0
Ca2+ mmol/L	1.1	1.0	1.1	1.1
Na+ mmol/L	136.0	136.0	137.0	137.0
HCO3– mmol/L	30.8	32.9	35.0	33.7



FIGURE 1. Sambar deer with forelimb amputation immediately after surgery.

Guru Angad Dev Veterinary & Animal Sciences University (GADVASU), Ludhiana, India by forest department officials.

On clinical examination, crepitation and a badly infected wound was observed in the mid-right metacarpal region. Radiography was done to ascertain the extent of infection and the type of fracture. The lateral radiograph revealed multiple fractures of the metacarpal, along with signs suggestive of osteomylitis and periosteal reactions. The wound was cleaned and aseptically dressed on the day of presentation, and analgesic (meloxicam 0.2 mg/kg i.m.) and antibiotics (amoxicillin+cloxacilin 5mg/kg i.m.) were administered to control the pain and infection. The limb amputation was scheduled; water and food were withheld for 12 and 24 hr, respectively, prior to the surgery. On the day of the operation, the animal was aseptically prepared for the surgery. Anesthesia was induced with xylazine 1.5 mg/kg i.v., followed by ketamine 3 mg/kg i.v., and the animal was intubated. General anesthesia was maintained with thiopental sodium (5%, 3 gm) in "top-up" form until the end of surgery.

The incision was made at the level of the middle-third of the humerus; the bone was exposed and transected, and the muscles were cut distal to the transected bone and removed. The muscles were sutured with chromic catgut using simple, interrupted sutures to cover the bony stump. The skin was closed using nylon thread and simple, interrupted sutures (Fig. 1).

Heart rate, respiratory rate, and rectal temperature were observed at regular intervals. Heparinised venous blood samples were taken for blood gas and electrolyte analysis (Cal Pak kit, Model ABL 77; Radiometer Medical ApS, Copenhagen, Denmark) before anesthetic induction and at 15, 30, and 105 min post-induction. The pedal and lateral palpebral reflexes were abolished within 5 min after induction. There was no regurgitation, tympany, salivation, or nasal discharge and the eyeball remained centered throughout the surgery. The heart rate and rectal temperature were gradually decreased from 105/min and 102.4 F at zero minutes to 74/min and 97.2 F at 105 min, respectively. Respiratory rate fluctuated near the base values at different time intervals. Hemoglobin and PCV values were gradually reduced at 15, 30, and 105 min from the base value, whereas CO_2 and HCO_3^- showed a gradual increase during anesthesia at the same time intervals. The pH, PO_2, K^+, Cl^-, Ca^{2+}, and Na^+ values fluctuated near the base value. The different blood-gas parameter changes are given in Table 1.

Recovery from the anesthesia was uneventful. Antiseptic dressing was done on the day of surgery, and alternate-day dressing was advised until suture removal on day 12 post-operative. Analgesic meloxicam, 0.2 mg/kg i.m., once daily for 3 days, antibiotics ampicilin+cloxacilin 5 mg/kg i.m., b.i.d. for 7 days, and gentamicin at 4 mg/kg i.m., b.i.d. for 4 days were prescribed. Thereafter, the sambar deer was transferred to the M. C. Zoological Park, Chat Bir, Patiala, India for further care and rehabilitation. The sambar deer was isolated and confined in a house along with a blackbuck (*Antilope cervicapra*) that had osteoarthritis. The animal was separated from other deer by a chain-link partition. The size of the confinement was about 200 yd^2. The zoo keepers were instructed to restrict the deer's movements in order to protect the suture line. The animal started bearing weight on three limbs the day after surgery, and on day 12 post-operative, the sutures were removed from the healthy surgery site. Further follow-up of surgery at 10 mo showed the animal was in very good condition, walking and even running at slow speed, using three legs (Fig. 2).

Discussion

Results of partial-limb amputation have been reported in horses (Koger *et al*. 1970, Crawley *et al.* 1989) and cattle (St. Jean 1996). Amputation is looked upon as a drastic therapy that should be considered only when all other methods of treatment have failed (Crawley *et al.,* 1989). Even so, though amputation is a last resort, the decision to perform surgery must be made before any pathological changes can occur in the contra-lateral limb (Crawley *et al.* 1989).

In the present report, a sambar deer with an open, severely infected metacarpal fracture underwent a successful limb amputatation and was rehabilitated to an as-normal-as-possible confined life, where it would be protected from predators. Quessada (1993) performed a successful forelimb amputation in a red deer (*Cervus elaphus*) that presented with similar injury. In addition, Butt *et al.* (2001) performed limb amputations in 13 wapitis, seven of which survived (mortality occurred for various reasons). Crawley *et al.* (1989) described osteomylitis as the most-common cause for limb amputation in horses, followed by irreparable, severe, open, comminuted fractures of the limb bones.



FIGURE 2. Sambar deer standing on three limbs 10 months after surgery.

Anesthesia in the present case was successfully managed with a xylazine–ketamine–thiopental-sodium combination. Caulkett (1997) administered a sedative dose of xylazine and ketamine i.m. combination to white-tailed deer (*Odocoileus virginianus*) and mule deer (*Odocoileus hemionus*) to produce 15 min of anesthesia. Furthermore, it was advised that this anesthesia pairing may be prolonged by administration of an additional bolus of ketamine at 10- to 15-min intervals. The ketamine–xylazine combination, along with butorphenol, has been used for limb amputation in 13 wapitis by Butt *et al.* (2001). Similarly, Quessada (1993) amputated the forelimb in a red deer under xylazine and ketamine anesthesia. The gradual reduction in hemoglobin and PCV values from the base value could be due to moderate blood loss during surgery. The fact that we observed no marked alteration in pH, PO_2, K^+, Cl^-, Ca^{2+}, and Na^+ values indicates the safety of this anesthetic protocol in sambar deer.

Post-surgery, the animal was sent to a zoo, where he started standing the first day after surgery and began walking on the third postoperative day. Butt *et al.* (2001) experienced problems in six wapitis, as concerned their ability to stand immediately following discharge from the hospital. The sambar deer with the limb amputation was managed in zoo premises, along with other deer, for care throughout the post-operative period. Similarly, Kumar (2006) managed a simple fracture of the metacarpal in a blackbuck by external immobilization, isolation, minimal disturbance, and containment near a deer enclosure that was separated by a chain-link partition.

To conclude, limb amputation can be considered a viable alternative to euthanasia when catastrophic orthopedic injuries occur in wild animals, and a xylazine–ketamine–thiopental combination may provide an alternative anesthetic for surgery in sambar deer without any significant blood-gas and electrolyte changes. An animal that has undergone limb amputation can be successfully given a normal-as-possible confined life where it is protected from predators—as long as specific management changes are made to accommodate ambulation in an appropriate manner.

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Certification: A Continuing Dialogue

PART FOUR

by Nancy Hawekotte

Introduction

Over the previous three issues of JWR, we have investigated, through this column, the nature of IWRC's certification program for wildlife rehabilitators and its correlated designation, Certified Wildlife Rehabilitator™ (CWR). Over the last three *years*, the CWR program has conferred that designation upon 72 individuals.

The breaking-in period for such a program is always challenging, but the experiences of those "early adopters" who have taken the CWR examination calmed much of the initial trepidation. Some who feared failure, but came forward nonetheless, found they know more than they thought! Many concerns have been addressed and resolved, both by the experiences of those individuals and in these columns.

For those new to JWR and to IWRC, the CWR program, launched by IWRC in 2007, is the first of its kind to confer a professional certification upon qualifying practitioners in the field of wildlife rehabilitation. Individuals demonstrating a specific level of knowledge of rehabilitation and related wildlife issues, as measured by examination, earn the designation CWR and the right to use the professional acronym behind their names. The CWR parallels similar certification for medical, educational, and other professional industries, ensuring a specific level of knowledge, as authenticated by an independent, professional organization.

Anyone may take the exam. Grading is pass–fail and there are no required classes or texts. It may be retaken until passed. Certification must be renewed every two years by earning continuing education units.

This regular column was born out of an ongoing dialogue between two individuals of different perspectives in the field—Kieran Lindsey, Certification Review Board Chair; and the author, a long-time mammal rehabilitator. Installments 1–3 examined the role of the CWR program in the field at large and its relationship to state and federal permitting agencies. We examined what certification confers upon the individual rehabilitator, and IWRC's role in its development and its oversight. The meaning of professionalism, its role in the field of rehabilitation, and certification's effects upon it, were significant topics of discussion. We looked at certification costs and renewal requirements. The last installment was devoted to the scope and nature of the examination itself.

More information about the CWR program can be found at theiwrc.org/certification/index.html and in the downloadable "CWR Applicant's Handbook." [For installments 1–3 of this column, see JWR, Vols. 29 (1), 29(2-3), and 30(1). Members can view back issues of JWR on the IWRC web site.

The Interview

This fourth part of the series addresses a variety of questions members, friends, and others have posed directly to IWRC. IWRC welcomes the opportunity for dialogue with its members and the rehab community at large, so keep asking!

The CWR Exam

Many of you still have questions about the CWR test, so we'll address those first.

Nancy Hawekotte (NH): How were the topics for the test developed?

Kieran Lindsey (KL): The list of topics was developed by a committee of permitted rehabilitators, wildlife biologists and veterinarians with long-term professional experience. All believe that the scope of knowledge required in the work of wildlife rehabilitation is wide-ranging and interdisciplinary, and includes areas traditionally considered outside the field. This is reflected in the nature of the topics included in the CWR exam.

Many excellent texts and papers were consulted as well, to aid in understanding common issues faced by those now working in the field worldwide. It was a long and demanding process.

NH: How do we learn things like the carrying capacity of a release site?

KL: Most rehabilitators know this already if they've released an animal properly, but may not realize it. They know the range, dietary requirements, and nesting or burrowing habits of the species in question from reading about its life history or learning on the job. They know about the social behavior of the animal and how many can occupy a given area. They can judge if a potential release site is rich, adequate, or poor in the needed features for the survival and reproductive success of that species. This kind of information is available in many sources familiar to anyone working in the field already. A list of some excellent titles (by no means comprehensive) is included in the CWR Handbook, downloadable from IWRC's web site.

MOST REHABILITATORS KNOW THE REQUIREMENTS, HABITS, AND BEHAVIORS OF THE SPECIES THEY WORK WITH; THEY KNOW HOW TO JUDGE IF A RELEASE SITE IS ADEQUATE FOR THE ANIMAL'S SUCCESS.

NH: How do I know if I have an acceptable proctor?

KL: If you are taking the test by hard copy, rather than online, you will be asked to select someone to oversee the process in

order to assure that all rules are followed. That person can be, for example, a public or private school teacher (secondary level or higher), a librarian, a member of the clergy, or a notary public. You may find an acceptable proctor outside of these categories. In any case, your proctor cannot be a relative or someone with a personal interest in your test results (a center manager under whom you work, for instance). Once you have chosen a proctor, IWRC requires that you provide their name and contact information for approval, after which you'll be advised if they are an acceptable proctor.

NH: How does IWRC prevent cheating on the exam?

KL: The requirement for a proctor is a safeguard against cheating when one takes the hard copy of the test. The online exam includes a lock-out feature that prevents test-takers from accessing anything else on their computer or the Internet during the test. Printed resources may be used, however.

NH: Why is the test pass-fail, and why doesn't it identify one's mistakes?

KL: The reason for pass-fail is because we didn't want CWRs to compare scores with the idea that someone who got a 95% is "more certified" than someone who got an 85%. Certified is certified. We don't provide a list of missed questions because it would compromise the database of exam questions. We don't want the questions passed around through email or posted on a web site.

NH: Once I have applied for the exam, and have access to it, can I change my exam method?

KL: Yes. However, you need to understand that when you change to a different access method you will receive a new, randomly generated exam. And if you begin the exam in either format, you will have to wait for the required two weeks between test periods and reapply to take the exam.

Continuing Education Requirements

NH: How can I fulfill CE requirements in another country than the U.S.?

KL: Exactly as you would if you were in the U.S. For those who can travel, there are many international, national, and regional wildlife-related conferences, symposia, and workshops to choose from. Locally, you should be able to find related classes, workshops, and training sessions you can attend for credit. Online courses are available to anyone with a computer and Internet access. Presentation of a paper at an approved conference earns 1 unit. We especially like the option of publishing a paper in a wildlife-related peer-reviewed journal, and authors receive 2 points toward their CE units!

THE ACT OF PUBLISHING A PAPER IS A COMMITTMENT REQUIRING A HIGH LEVEL OF KNOWLEDGE AND CREATIVITY.

IT IS A PROFESSIONAL ACT REFLECTING DEDICATION AND THE WILLINGNESS TO SHARE ONE'S KNOWLEDGE TO BENEFIT THE FIELD AS A WHOLE.

NH: Why is publication in a peer-reviewed journal worth more than other CE options?

KL: The act of writing and getting a paper through peer-review is a larger commitment and requires a greater degree of knowledge and problem-solving creativity than attending a conference. It is a professional act that reflects a high level of dedication, both in the work required and the willingness to share one's knowledge for the betterment of the field as a whole. Publishing such a paper also garners for the author a lot of personal credibility as an expert in their topic, so it's a winning approach all around!

Permitting

Many of you have asked good questions about the relationship of certification to permitting in the U.S., both locally and federally. We should reiterate that the CWR program in no way confers any legal rights or supersedes the laws in any region. Any regulations under which you operate now will still apply whether or not you obtain a CWR designation.

However, not all rehabilitators practice in the U.S.

NH: Does a CWR designation allow me to practice as a wildlife rehabilitator in my country? Does IWRC have special arrangements with any permitting agencies that recognize CWR as an adequate test for being permitted?

KL: Whether a CWR designation meets the legal requirements to practice rehabilitation is up to each permitting agency. IWRC does not have any special arrangements with permitting agencies, nor has it attempted to create such arrangements. That's not within the scope of the certification program. That said, I have heard some U.S. state agencies are using the CWR exam to meet permit requirements, and it may well be that more will follow suit. There are definite advantages to an agency in doing so, just from the standpoint of resource allocation. But the decision to do so rests entirely with the agency, and IWRC neither encourages nor discourages this approach.

Emergency Response

The recent and ongoing oil spill disaster in the Gulf of Mexico has increased the visibility of wildlife rehabilitation worldwide. Many volunteers in the rehabilitation community, as well as many others, have been "called to serve." IWRC has received calls and emails from numerous individuals—rehabbers and those not in the field—wishing to play a role in aiding the affected native and migratory wildlife populations. (See page 6 for more information on how you can help).

NH: A non-rehabilitator asks, "Can I assist in the Gulf oil spill if I take the CWR test?"

KL: There's been some confusion because the call for volunteers information that was distributed to the rehabilitation community and the media asked for certified rehabilitators. In fact, this was probably a poor choice of words; it seems clear the

How to learn more about the Certified Wildlife Rehabilitator® Program

If you wish to learn more about the CWR Program, or obtain your certification, the following steps will provide more information, explain how to apply with IWRC to take the test, and help you prepare for the examination.

- Read the other three installments of this column in the three prior issues of JWR. If you are a member, log on to the web site at:

  www.theiwrc.org

  Go to the Members section. You will find the 29(1), 29(2-3), and 30(1) archived issues of JWR. Many questions have been answered in these articles.

- Check out the CWR FAQ online. This, and all other CWR information, is freely available to non-members.

- Download the *CWR Applicant's Handbook* (.pdf format). It provides more specific information about the exam contents, testing protocol, and study resources, as well as instructions to apply to take the exam.

If you still have questions or concerns, IWRC will be happy to answer them. Feel free to email IWRC at:

director@theiwrc.org

or call toll-free: **(408)876-6153 or (866)871-1869**

intent was to ask for permitted rehabilitators. As a result, IWRC has been receiving a higher number of calls than usual about the CWR program. We must keep in mind that this is an ongoing crisis; needs are being assessed and reassessed on a daily basis. It seems to me the best approach for someone who wants to volunteer is to register at the U.S. Fish & Wildlife Service web site or at one of the web sites set up by state authorities in Alabama, Florida, Louisiana, and Mississippi (see page 6 for more information). A variety of skills and experience are needed. Those in charge of the response will be looking at the information provided by volunteers as they decide who call for assistance.

The Benefits of Certification

NH: I have a question that has arisen over our many discussions of the CWR Program and IWRC's role in its development. It is apparent that IWRC has put a great deal of time, effort, and funds into taking this program from its conceptual infancy to the comprehensive plan it has now become.

Why has IWRC gone to all this work to provide us, as primarily volunteer rehabilitators, with a professional–level certification? It seems like we rehabilitators get all the benefit.

KL: There are several reasons. First and foremost, IWRC's Board of Directors recognized an unmet need and believed it was within the scope and mission of the organization to address that need.

Secondly, certification was a good fit with IWRC's ongoing efforts to "professionalize" rehabilitation—not from an economic standpoint (although I don't know many rehabilitators who would turn down a chance to be paid to do what they love!), but from a standards and practices standpoint...a continual improvement of animal care standpoint. IWRC was well aware that rehabilitators had no real way to assess the knowledge of their colleagues, or for that matter, themselves. Also, as rehabilitation has become more visible to the public, both through the establishment of brick-and-mortar centers and through the media, it seemed likely that the public would begin to demand that agencies increase standards. It was prudent for the rehabilitation community to step up its own efforts in this area.

Lastly, a solid professional certification program is one way to build confidence, acceptance, and respectability for rehabilitation within the other wildlife professions. We know this will not happen overnight, but it's a step in the right direction, particularly for a discipline that does not currently require an academic degree as the baseline for practice.

NH: Thank you, Kieran. Readers who wish to know more about the Certified Wildlife Rehabilitator program can find more information in the window on the previous page. Please send us any questions you may have that you'd like us to discuss in our next column. ■

Nancy Hawekotte owns a communications desiign studio and is a 22-year wildlife rehabilitator, having worked in a variety of roles. She lives in Omaha, Nebraska.

Join us in Albuquerque, New Mexico
Tuesday, October 19 to Saturday, October 23, for the

2010 IWRC Education Symposium!



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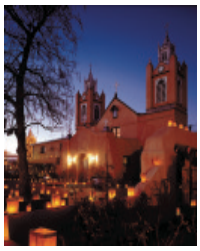


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The International Wildlife Rehabilitation Council invites you to register now for our 2010 Education Symposium and receive a $50 discount off the full conference registration fee!

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(*No Early-Bird discount for 1AB or single-day registrations*)

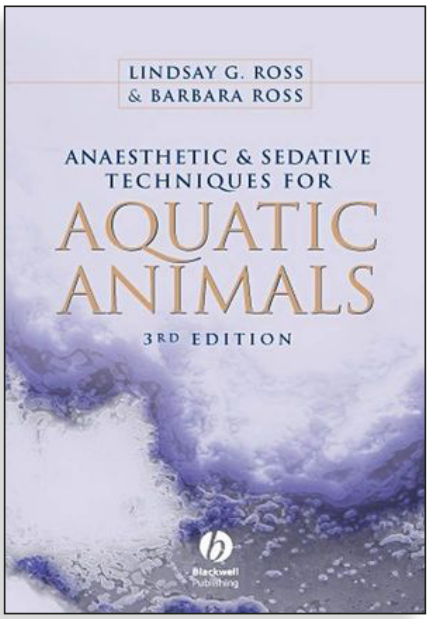
Deadline: June 15th, 2010

For more information and to register, visit www.IWRC-online.org
or contact IWRC Executive Director Kai Williams Kai@IWRC-online.org • Phone: 866.871.1869

Anaesthetic and Sedative Techniques for Aquatic Animals, 3rd Edition

By Lindsay Ross and Barbara Ross
Blackwell Publishing, 2008, 240 pages, hardback, $139.99
ISBN: 978-1-4051-4938-9

The third edition of this book is a welcomed revision of the expanding literature on the anesthesia, sedation, and euthanasia methods used in aquatic animals. Chapters cover such topics as defining and identifying stress in aquatic animals, an introductory overview of anesthesia principles, factors affecting anesthesia in aquatic animals, the use of anesthesia in the transportation of aquatic animals, and chapters on anesthesia of fish, amphibians and reptiles, and selected aquatic invertebrates. The book provides a brief overview of international regulations with respect to the use, food safety, and environmental safety of these chemicals and techniques.



The two major advancements of the book are the addition of a chapter on pain in fish and the revision of the chapters on anesthesia techniques in fish. Taking into consideration the expanding field of animal welfare, the authors include a new chapter summarizing the current literature on nociception [the perception of physical pain] in aquatic animals and supports the conclusion of many researchers that even though aquatic animals may not perceive or experience pain in the same manner as higher vertebrates, the precautionary principles should be adopted when utilizing potentially stressful or painful techniques.

The revised chapters on individual anesthetic compounds, categorized by route of administration (inhalation, oral, parenteral), have been completely reorganized and expanded to incorporate essential new information and updated references. Each anesthetic compound described has detailed information on the chemical nomenclature, structure, mode of action, and recommended dosages. In addition, pertinent safety and toxicology information is included for each compound. As in the past edition, the book includes a chapter on nonchemical methods of anesthesia, such as hypothermia and electroanesthesia. Unfortunately, and most likely due to a paucity of available literature, this section is not revised significantly and still avoids discussing these techniques in terms of current animal welfare considerations. Another minor deficiency of the book is the use of photographs from the older edition; for instance, the authors could have added more up-to-date photographs of the anesthesia machine (Fig. 8.6) and i.m. injection of fish (Fig. 10.3), and several photographs depict handling fish and amphibians bare-handed without protective gloves (Figs. 8.3 and 13.1). The authors should have also included the more current 2007 reference to the AVMA Guidelines on Euthanasia instead of the 2001 reference.

Aside from these few shortcomings, the book is an easy-to-follow, well-written treatise on anesthesia of aquatic animals. Compared to the previous edition, the publisher has set this work in a much more acceptable layout and font for ease of reading. Thus, this book remains an essential resource for anyone working with aquatic animals including primarily fish, but also amphibians, reptiles, and aquatic invertebrates and will serve as a practical guide for veterinarians, researchers, and personnel in fisheries, aquaculture, and aquarium settings. ■

Stephen A. Smith, DVM, PhD is a Professor in the Department of Biomedical Sciences and Pathology at the Virginia–Maryland Regional College of Veterinary Medicine, specializing in Aquatic Medicine/Fish Health and Wildlife and Exotic Animal Medicine.

Factors in Estimating Potential Response Costs of Spills and Releases

F. E. Giles

Environmental Claims Journal 22(1): 27–37, 2010

This article provides a discussion of the categories of response costs associated with releases of hazardous substances or petroleum into the environment and the factors to be considered in developing response cost estimates. To understand and estimate the costs of responding to sudden and accidental releases of hazardous materials or petroleum into the environment, a number of key factors must be considered. Detailed cost estimating approaches, developed through the study of catastrophic marine oil spills, are discussed for purposes of illustration and then generalized for application to other types of spills. It is recognized that many practitioners will have access to detailed information on releases, based on their own experience, and it is anticipated that this article will provide additional insight, ideas, and a framework for estimating response costs.

Comparison of Mercury Burdens in Chronically Debilitated and Healthy Loggerhead Sea Turtles *(Caretta caretta)*

R. D. Day, J. M. Keller, C. A. Harms, A. L. Segars, W. M. Cluse, M. H. Godfrey, A. M. Lee, M. Peden-Adams, K. Thorvalson, M. Dodd, and T. Norton

Journal of Wildlife Diseases 46(1): 111–117, 2010

An increase in the incidence of debilitated loggerhead sea turtle (*Caretta caretta*) strandings in the southeastern United States has been observed in recent years. These turtles are characterized by emaciation and heavy burdens of external and internal parasites, and bacterial infections, but the underlying cause of their condition is unknown. To investigate further the causes of these strandings, a health assessment was performed on stranded, debilitated loggerhead turtles, and contaminant concentrations in various tissues were compared to those from healthy turtles. This portion of the study investigated the potential role of mercury (Hg) toxicity in the debilitated condition described above. Hematocrit, total protein, albumin, globulin, glucose, calcium, lymphocyte counts, heterophil:lymphocyte ratios, aspartate aminotransferase, uric acid, sodium, and chloride were altered in debilitated loggerheads relative to healthy animals. However, none of the aforementioned health indicators correlated with Hg concentrations in either red blood cells (RBCs) or plasma. The Hg concentration in RBCs was 129 ± 72 (mean ± standard deviation) times higher than in plasma, causing a significant dilution of Hg in whole blood due to extreme anemia. Mercury concentrations in RBCs (73.7 ± 21.2 ng/g) and scutes (455 ± 57 ng/g) from debilitated turtles were similar to, or lower than, those reported for healthy animals, indicating no elevation in Hg exposure before and during the progression of this condition. These findings suggest that Hg toxicity does not play a role in the debilitated loggerhead condition observed in the southeastern United States.

Response to Vaccination with a Commercial Inactivated Rabies Vaccine in a Captive Colony of Brazilian Free-Tailed Bats (*Tadarida brasiliensis*)

A. S. Turmelle, L. C. Allen, B. A. Schmidt-French, F. R. Jackson, T. H. Kunz, G. F. McCracken, and C. E. Rupprecht

Journal of Zoo and Wildlife Medicine 41(1): 140–143, 2010

A captive colony of Brazilian free-tailed bats (*Tadarida brasiliensis*) was vaccinated with a commercial, monovalent, inactivated rabies virus (RABV) vaccine (RABVAC 1). Baseline rabies virus neutralizing antibodies (VNA) and the response to vaccination were measured in 50 bats. Rabies VNA was detected in the plasma of 64% (27/42) of bats that had been vaccinated 1 yr prior, but only 19% (8/42) had levels considered adequate. Rabies VNA was detected in the plasma of 63% (5/8) of bats with no record of previous vaccination, suggesting natural RABV exposure before captivity. All bats demonstrated a VNA response by 10 days post-vaccination, and baseline titer significantly predicted humoral response to vaccination. No adverse reactions to vaccination or clinical signs of RABV infection were observed in the bats during a 6-mo observation period. Annual vaccination may maintain immunity against RABV infection in captive colonies of bats.

Survivorship of Rehabilitated Juvenile Tawny Owls (*Strix aluco)* Released Without Support Food: A Radio Tracking Study

R. Griffiths, C. Murn, and R. Clubb

Avian Biology Research 3(1): 1–6, 2010

We investigated the survival of 57 rehabilitated juvenile tawny owls (*Strix aluco*) that were "hard released" (without the provision of a release aviary or support food) by means of radio tracking. The birds were released in the month of August in three consecutive years: 2005, 2006, and 2007, in the counties of Somerset and Hampshire, United Kingdom. Tracking of the owls was successfully carried out for between 3 and 160 days. Mortality was recorded for 16 birds (28%). The transmitter was shed by 24 (42%) owls, the signal was lost for 12 (21%), and tracking was ceased for five (9%) owls.

Survival of the owls was compared with results from previous studies on wild tawny owls and also on rehabilitated "soft released" tawny owls (released with provision of food and shelter after release) and found to be similar. This study suggests that employing costly and time-consuming soft release techniques may

CONTINUED ON PAGE 32

White Pine Wildlife Rehabilitation Center Closing

Dateline: April 8, 2010

EAU CLAIRE, WISCONSIN (USA)—The White Pine Wildlife Rehabilitation in Fall Creek has closed its doors after 21 years of caring for injured and orphaned wildlife and taking calls at all hours of the day. The Wisconsin Department of Natural Resources (DNR) says it's a huge loss for the area because there are no other services like it nearby.

"We are no longer physically, emotionally, or financially able to continue to operate White Pine," owners John and June Owens said in a letter to supporters. The center receives no state funding and donations have been low.

The Owens will continue to rehabilitate the animals already in their care until they can be released, then dissolve their nonprofit organization, surrender their licenses, and distribute their equipment to other nonprofit operations. The Owens are the only licensed rehabilitators in this part of the state. They have been serving 22 counties and caring for 800 to 1,000 animals a year.

White Pine received the 1994 Wildlife Award from the Eau Claire County Land Conservation Commission, the 1995 Earthgreen Award from the Chippewa Valley Group of the Sierra Club, and the 2001 West Central Region Natural Resources Award from the DNR. John Owens recalls the hard, long hours, and their cost, but looking back says they have no regrets. "We got to do stuff most people never even dream about," he said.

Second Chance Wildlife Loses Permit Appeal

Dateline: April 11, 2010

FAYETTEVILLE, OHIO (USA)—The 12th District Court of Appeals has affirmed a Brown County (Ohio) Court of Common Pleas ruling and determined that Mary Carrelli, founder of the local wildlife rescue organization Second Chance Wildlife (SCW), is not constitutionally entitled to a wildlife rehabilitation permit. The appeals court found that Ohio law leaves the approval or denial of a rehabilitation permit to the discretion of the chief of the Ohio Department of Natural Resources Division of Wildlife (ODNR).

In 2007, a sick bobcat cub was brought to Carrelli's organization, which held permits to rehabilitate fawns and other wildlife, but not bobcats, which are classified as an endangered species in Ohio. As a result, representatives of the ODNR instructed Carrelli to relinquish the animal to wildlife officers so it could be relocated to a different facility.

Carrelli initially refused to turn the animal over and asked to be issued an endangered species permit that would allow her to care for the bobcat until it was well enough to transfer to a "soft release" site. Following a confrontation at SCW, the ODNR executed a search warrant at the Fayetteville facility and removed the animal. Carrelli then voluntarily turned over permits she held at the time and asked the Division to find alternate rehabilitation locations for other animals in her care.

In June of 2008, Carrelli applied for a new permit to allow her to rehabilitate fawns, bobcats, and black bears, but the ODNR declined the request "citing multiple instances, including the bobcat situation, where Carrelli failed to follow the division's instructions," according to a statement released by the appeals court.

Carrelli requested an administrative hearing, and a hearing officer upheld the chief's decision. Carrelli then appealed the denial to the Brown County Court of Common Pleas, where Division of Wildlife Chief David Graham's denial was again affirmed. Carrelli argued to the 12th District Court of Appeals that the denial of the permit was a violation of her constitutional rights and that permit regulations do not give the Chief of the Division the discretion to deny a permit, if all requirements are met.

Writing an opinion for a unanimous court that upheld Brown County Court of Common Pleas' affirmation, Judge Robert P. Ringland found that Carrelli did not have a protected interest in the state's wildlife and, as a result, her constitutional rights were not violated by the denial of her application. The court found that the denial was supported by reliable and probative evidence.

Second Chance Wildlife had served as a nonprofit organization dedicated to rehabilitating injured wildlife in Ohio since the early 1990s. Carrelli had rehabilitated or supervised the rehabilitation of more than 9,000 animals.

Planned Center will Rehabilitate Iowa Wildlife

Dateline: April 19, 2010

AMES, IOWA (USA)—Marlene Ehresman, and a host of colleagues, friends, and acquaintances, has developed plans to build a sustainable, "green" wildlife center that would provide rescue, rehabilitation, and release services for native Iowa wildlife. The center also would offer rehabilitation training services and environmental education.

The group invited the public to two events Friday and Saturday, April 23 and 24, which both celebrated the 40th anniversary of Earth Day and publically launched the Iowa Wildlife Center (www.iowawildlifecenter.org).

Ehresman, an Ames native, her husband Bruce, and veterinarian Susan Barrows started the Iowa Wildlife Rehabilitators Association in 1985. Derrick Grimmer and Lynne Brookes approached Ehresman two years ago about developing a rehabilitation center in central Iowa. After six months of consideration, she decided to do it with full support from her boss at the Iowa Natural Heritage Foundation, Mark Ackelson.

With Ehresman, Brookes, and Elaine Thrune, a founding board member of the

National Wildlife Rehabilitation Association, serving as co-founders, the group set out to find suitable property to house a wildlife rehabilitation and education center. A farm offered at a "bargain price" fit the bill. Named WildWay, the 75-acre site is about a mile south of the entrance to the campground at Ledges State Park.

Ehresman said the group would like to spend the next year raising funds and secure at least half to three-fourths of the money needed for what they project will be a US $6-10 million facility. "When you think about things like heated pools to overwinter trumpeter swans, the costs add up," she said.

A groundbreaking could take place a year from now, with the facility ready to open in the fall of 2012. "That's a dream, but you have to start somewhere," said Ehresman. Ehresman said that there are about 75 licensed wildlife rehabilitators in the state, and said the Iowa Wildlife Center would expect to treat a minimum of 4,000 animals annually.

Proposed Wildlife Rehabilitation Account Defeated

Dateline: May 2, 2010

BOSTON, MASSACHUSETTS (USA)—An attempt to use funds from the Massachusetts (USA) Wildlands Stamp Fund and other MassWildlife accounts was defeated.

Representative James Murphy (D) of the 4th Norfolk District proposed two amendments that would have diverted millions of dollars from the Inland Fisheries and Game Fund into a proposed Wildlife Rehabilitation Account. One dollar (US$1) from every license sold, and five dollars (US$5) from every Wildlife Conservation Stamp (sold with each fishing, hunting, sporting, and trapping license) would have gone into a proposed rehabilitation account. In addition, some grant monies from the federal government, or other public and private sources, could have been deposited into the new account.

The Murphy amendments also provided for those funds to be distributed to nonprofit organizations that provide rehabilitation for nongame wildlife and endangered species in the state. However, Representative William Straus (D) of Mattapoisett and co-sponsor Representative George Peterson (R) of Grafton filed two amendments to restore the original funding program. The amendments passed, effectively nullifying the earlier amendments to fund a Wildlife Rehabilitation Account. ■

ABSTRACTS CONT'D FROM PAGE 30

be unnecessary for juvenile tawny owls, as their survival is not significantly reduced using hard-release methods. Measuring post-release success of rehabilitated birds of prey is discussed in relation to benchmarks used in previous studies.

Post-release GPS Tracking of Hand-reared Irish Hare (*Lepus timidus hibernicus)* Leverets, Slemish, County Antrim, Northern Ireland

N. Reid and A. T. Harrison

Conservation Evidence 7(1): 32–38, 2010

Animal rescue centers release large numbers of captive-bred, rehabilitated, or translocated animals into the wild annually, but little is known about their post-release survival and behavior. We developed a novel and innovative coupling of traditional radio-tags with new GPS loggers to track hand-reared Irish hare *(Lepus timidus hibernicus)* leverets after release into the wild. Cyanoacrylate SuperGlue® proved a poor fixative, with two out of three leverets managing to detach their tags within 24 hr. Nevertheless, a total of 2,505 GPS locations were recorded every 60 sec for one leveret over three nights (approx. 835 per night). The leveret dispersed <410 m from the original release site. It demonstrated exploratory behavior, including an ability to navigate accurately in a complex and unfamiliar environment, returning to a habitual lie-up site each day. Its survival was confirmed up to 9 days post-release, at which time its radio-tag detached; however, similarly aged leverets were sighted in the area for up to 2 mo post-release (suggesting possible longer-term survival). This is the first study to publish data from any GPS-tagged lagomorph and provides "proof-of-concept" that large quantities of behavioral data can be recovered from small mammals of 1–2 kg. Further development of these techniques will be highly valuable to future studies.

Ratsnakes and Brush Piles: Intended and Unintended Consequences of Improving Habitat for Wildlife?

J. H. Sperry and P. J. Weatherhead

The American Midland Naturalist 163(2): 311–317, 2010

Brush-pile creation is a common habitat-management method used to attract wildlife. However, there is a paucity of data regarding effectiveness of brush-pile creation and the indirect effects of brush piles on multi-species interactions. Here, we document use of man-made brush piles by Texas ratsnakes (*Elaphe obsoleta*), examine mechanisms behind that use, and present results of a pilot study comparing avian nest success in areas with and without brush piles, to determine if predator attraction to brush piles negatively affects the surrounding bird community. Radio-tracked snakes were found in brush piles 10% of the time, despite brush piles comprising less than 0.2% of the habitat by area. More abundant small mammals, and more moderate temperatures in brush piles than in surrounding habitats, could explain snakes' attraction to brush piles. Nest success of birds was similar in areas with and without brush piles in the year following brush-pile creation. However, because it may take substantially longer than 1 yr for snake use to reach its maximum, it is premature to conclude that brush piles do not affect birds nesting in adjacent habitat. Given the apparent prevalence of brush-pile creation, and the demonstrated preference of brush piles by ratsnakes, further research to document the consequences of brush-pile creation is warranted. ■

Forester's Log: HABITAT TYPING

by Mary Stuever

It's PIED/CEMO behind the Jemez Ranger Station. This year, the stand is somewhat tricky to key out, what with the lush response of forbs and grasses from the recent rains. PIPU/CAFO, or possibly PIPU/FEAR, up by Oscar's Grave near Alpine. That would explain the sporadic response of the aspen, sprouting despite the nine-foot tall elk fence. The PIPO/ARNO stand by Tres Piedras was planted years ago, and there is disagreement in the group about whether the trees belong, or are encroaching, in a natural meadow. The fuel reduction treatment in the PIPO/QUGA stand outside McNary could possibly result in a brush field of more volatile fuels than the original, overstocked pine forest. These are just a few of the observations that were made during two, week-long Habitat Typing Workshops held this summer in Arizona and New Mexico.

Habitat typing, also known as identifying plant associations, is an important skill-set for natural resource managers working in woodlands or forests. The classification of forests into plant associations gives managers the vocabulary to discuss the finer points of management with better precision. For example, what would be called a ponderosa pine forest by the untrained can, with the right books and bit of training, be identified as one of forty or so "habitat types" that support "ponderosa pine forests." Knowing the habitat type allows managers to compare, contrast, and predict the responses of plants to various activities such as burning, thinning, and logging.

The types are named for the most shade-tolerant tree the site can support, and for an understory plant that best represents the site—ideally, an indicator plant will thrive in the specific plant association but does poorly in other places. Frequently, though, the dominance of a plant in the understory will nominate it for community name status. Plant associations have names such as "pinyon pine–mountain mahogany" which, when using scientific names for plants, would be "*Pinus edulis*/*Cercocarpus montanus*." Because habitat types were originally developed for government workers, and government workers are famed for creating acronyms, the name is often shortened to unintelligible monikers by using the first two letters of both genus and species for each plant, thus PIED/CEMO.

Knowing the habitat type provides one with specific information not apparent to a casual observer. For example, many people consider the ponderosa pine forest on the Mogollon Rim in central Arizona as one of the largest, homogenous stands of ponderosa pine in the world. The habitat typer, however, sees variation in the forest. A ponderosa pine/screwleaf muhly (PIPO/MUVI) type is wetter than a ponderosa pine/screwleaf muhly–Arizona fescue (PIPO/MUVI-FEAR) stand, which is still moister than a ponderosa pine/Arizona fescue (PIPO/FEAR) forest. Near the edges of this vast pine stand, ponderosa/blue grama (PIPO/BOGR) is even drier.

Habitat typing was developed in the Pacific Northwest in the 1960s, and plant associations have been classified in all of the western states. The first comprehensive plant association classification of Southwestern forests was completed in the 1980s. I attended training on these types and then shared the information I gained with my colleagues. Soon, I was teaching courses as a contractor with the Forest Service. In the mid-1990s, I also updated the regional Plant Association guides, which resulted in a two-volume set of books.

During a period of ten years, I facilitated over 30, week-long trainings involving about 600 resource managers througout Arizona and New Mexico. However, in the past five years, I had not had a chance to conduct a week-long workshop. This summer I sponsored two well-attended courses, one in each state.



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New Mexican landscape with ponderosa pine forest.

Near Oscar's Grave, we visited a blue spruce/dryspike sedge (PIPU/CAFO) site, which alternated with blue spruce/Arizona fescue (PIPU/FEAR), the latter type having a more-minor role for aspen trees. The ponderosa pine/black sagebrush (PIPO/ARNO) is similar to the more-common forest type where big sagebrush is a dominant shrub, but in this stand near Tres Piedras, the sagebrush is much smaller in stature. One of the largest and most widespread habitat types is ponderosa pine/gambel oak (PIPO/QUGA), which we encountered almost daily.

Each week included five days in the woods, full of spirited discussion and learning, and visits to a plethora of plant communities from woodlands to spruce–fir alpine transition. I know I came back to my job excited about forests, and I hope workshop participants will use this knowledge to apply the best activities to promote forest health across the landscape. ■

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TAIL END



BROWN PELICAN (*PELECANUS OCCIDENTALIS*). PHOTO CREDIT: WWW.IANCAMPPHOTOGRAPHY.COM. USED WITH PERMISSION.

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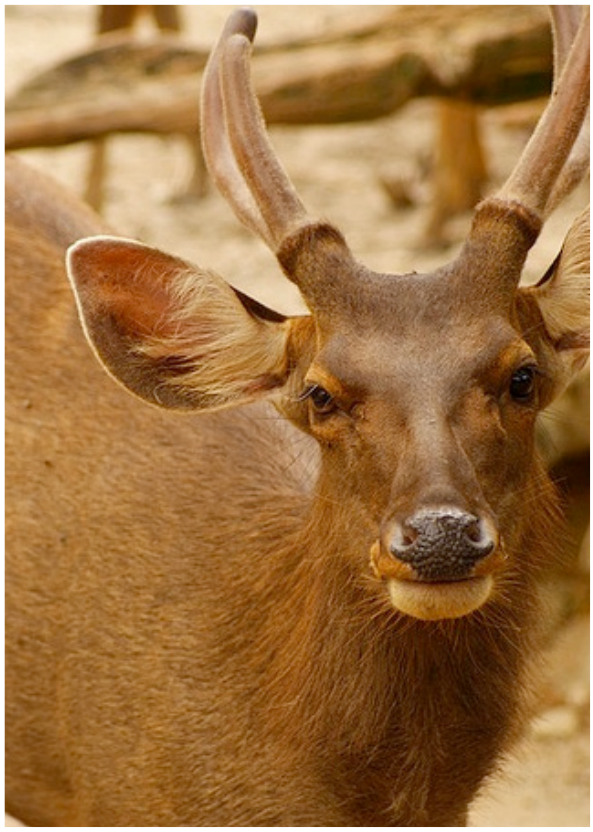
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Sambar deer (*Rusa unicolor*).
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