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AVIAN ROUNDS

New York State College of Veterinary Medicine ● Cornell University

OWL RELEASE

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EMERGENCY ASSESSMENT, FLUID THERAPY AND TREATMENT OF INJURED BIRDS OF PREY

By Jennifer Maas, COR '79
With Thanks to Dr. Joanne Paul-Murphy, COR'82

A great proportion of the birds of prey seen at the Avian Clinic of the New York State College of Veterinary Medicine have suffered traumatic injuries from gunshot wounds, collisions with cars or leg-hold traps. The long-term goal is to release these birds after we are satisfied that they can both fly and hunt. The short-term goal, since many of the birds are presented in an extremely debilitated condition, is to stablize them using supportive care for the first several days following admission. While emergency care is essential to their survival, its administration is also one of the most challenging problems we face.

Before a bird is handled for a physical examination, its general attitude and posture should be observed, noting wing posture, labored breathing, dullness, or weakness. For examination of a bird, the Avian Clinic uses a general outline to ensure that all body systems are examined. Initially it is necessary to cover the head of the bird to reduce stress and control the talons to prevent injuries to the examiner. The thickness of the pectoral muscles on either side of the keel should be palpated to evaluate the nutritional status of the bird. The external ear canals are inspected for bleeding or parasites, palpation and manipulation of the skull, wings, and legs help to locate fractures and gunshot wounds. The thorax should be auscultated to evaluate heart rate and rhythm and determine the presence of unusual respiratory noises. The bird's temperature should be taken. Normal cloacal temperatures vary from approximately 103 to 106 degrees farenheit. A high temperature is not necessarily pathologic as an excited bird can have an extremely high temperature. An abnormally low temperature often indicates shock.

An ophthalmic examination is extremely important, especially when head trauma is suspected. The visual response of the bird is evaluated using the menance test and pupillary light responses. The cornea can be inspected and stained to check for lacerations or ulcers. A fundic examination, to examine the back of the eye, is helpful to identify subtle hemorrhages or retinal detachment. It should be kept in mind that many birds will have serious lesions affecting the back of the eye (retina, choroid) with the front of the eye appearing totally normal. After this examination, an orthopedic stockinette hood can be slid over the head. This has a calming effect that minimizes stress and makes handling easier.

If any penetrating thoracic or abdominal wounds are found, they should be covered with vaseline gauze to seal the air sacs. If there is obvious respiratory distress, a patent airway should be established immediately and the bird allowed to breathe 40 -100% oxygen. Stabilize extremely unstable fractures by external splinting and control bleeding by applying digital pressure or a bandage. Intravenous fluid therapy should be started immediately on a very weak patient.

During the general examination, a small amount of blood can be taken with minimal stress to the bird. A 25 gauge needle can be inserted into the cutaneous ulna vein or medial tarsal vein. While cutting a toenail will provide blood for analysis, it should be avoided in birds of prey who make their living with their talons and in very "shocky" birds who generally will not bleed with this method. Three heparinized microhematocrit tubes and a unipette capillary tube can be filled. The unipette tube is then discharged into an unipette reservoir containing Natt and Herricks dye. Then coat a Dextrostik^{R} or Chemostrip^{R} with blood. The dextrostix is used to give a rough estimate of total blood glucose. Normal values for blood

A patient from the Avian Clinic at the New York State College of Veterinary Medicine waits for radiographs.

glucose for birds of prey listed in the literature vary from 250 to above 450 mg/dl. These values are considerably higher than those for mammals and may reflect the high gluconeogenic capacity of birds of prey. Raptors have an exceptional ability to withstand hypoglycemia from fasting. Nelson reports fasting a great horned owl for seven days with little change in its blood glucose.

This suggests that the birds presented with a blood glucose of less than 175 mg/dl have not eaten for a considerable period of time. This conclusion is usually supported by severe emaciation and the inability of the bird to fly due to fractures which are radiographically old. We have found that birds with a blood glucose this low usually die within 24 hours of admission unless glucose is administered intravenously.

Packed cell volumes (PCV) and total plasma solids are run for all new birds entering the clinic and are taken periodically as the bird recovers. Normal packed cell volume values range from 37 to 43 percent. A normal packed cell volume does not eliminate the possibility of anemia since an anemic animal that is also dehydrated can show a normal PCV. Total plasma solids determined by a refractometer with the serum in the microhematocrit tube can help determine the bird's state of hydration. Normal plasma solids of raptors range from 3.7 to 5.7 g/dl.

If the total solids are normal and the PCV is low, then the animal is probably anemic. However, if the total solids are increased and the packed cell volume is normal, it is possible that the bird is anemic and the packed cell volume is artificially increased by a decrease in fluid volume.

Unfortunately, injured birds are often anemic due to blood loss and hypoproteinemic due to starvation, making accurate evaluation of hydration difficult. In this instance, it is necessary to measure serum electrolytes and serum osmolality to determine the extent of dehydration. Most often, an estimate of dehydration is used by clinically evaluating skin elasticity, mucus membrane moisture, and coolness of extremities.

Natt and Herricks solution, in a 1:100 dilution with blood, is a stain which helps to distinguish avian red blood cells and thrombocytes from white blood cells. The stained cells are placed in a hemocytometer and counted. Normal values reported in the literature show a large standard deviation and generally fall within a range of 7000 to 20,000 cells per microliter. A differential white cell count can be done on a blood smear using either Diff Quik or Wright's stain. Birds respond by showing increased numbers of heterophils (similar to mammalian neutrophils) to infections and decreased numbers during stress.

At this point a few relatively simple and fast laboratory tests have provided the clinician with an indication of the degree of anemia, hypoglycemia, and dehydration of the patient, and the presence or absence of an infection. Decisions concerning the need for further diagnostic tests and their type, dose, and route of administration of medications may now be made with greater accuracy than those based on the physical examination alone.

FLUID THERAPY

A rational approach to fluid therapy in the raptor should include an understanding of some major physiological differences between birds and mammals. The respiratory evaporative water loss is much higher in birds than in mammals. Raptor urine is typically hypotonic and avian kidneys aren't capable of producing as high a urinary osmotic pressure and inorganic ion concentration as mammals. Their concentrating ability is very limited. However, during dehydration, birds resorb more of the filtered load than do mammals. This is due largely to the fact that nitrogen is excreted in the form of uric acid rather than urea, while urea is excreted in levels that are 20 times greater than its blood concentration. This more efficient means of excreting nitrogen allows the urine to be far more concentrated with respect to nitrogen and thus allows for increased ability to reabsorb water. During dehydration, birds, unlike mammals, resorb a larger amount of sodium chloride and this also allows for increased water resorbtion.

Because raptors, like other birds, have a decreased ability to concentrate inorganic ions in their urine, often do not drink or have access to free water, and have a high respiratory water loss, a salt load is acquired from their essentially isotonic food. Most raptors and perhaps some owls have nasal salt glands which enable them to deal with this load. In birds with salt glands, up to 85% of all sodium chloride excreted is eliminated by the nasal glands. A dehydrated bird which is resorbing more sodium chloride and thus more water from the tubules of the kidney is then able to get rid of this salt via the nasal glands.

Most large raptors can survive, breed, and reproduce without drinking water because their needs are met by the high water content of freshly killed game and by their own oxidative processes. Though the respiratory loss of water in birds is high and their ability to concentrate urine is low, this is compensated for by their ability to resorb large amounts of water from their nephrons, excrete a concentrated salt solution from their nasal glands and tolerate a relatively high blood osmolality .

As mentioned previously, most hawks and owls that are presented to our clinic are debilitated and often emaciated. Since many of these birds present in a state of severe starvation, and since an injured bird is also unable to search for water, it is reasonable to conclude that these birds are also dehydrated. In many cases, the dehydration due to decreased water intake is compounded by blood loss. Fluid therapy is therefore a very important part of emergency stabilization of the injured raptor.

The choice of a replacement fluid must be guided by the serum osmolality, electrolyte concentrations, acid/base balance, blood gases, and blood glucose concentrations of the patient as compared to those of the normal animal. The values that our clinic has obtained for serum electrolytes and osmolality are listed in Table 2.

TABLE 2 NORMAL DATA: SERUM AND OSMOLARITY

	Number of Normal Subjects Tested	Number of Samples	Number of Samples Rejected	Mean (Meq/L) ±Standard Deviation
Na	10	14		159 ± 4.0
K	8	10	4	2.7 ± 0.6
Cl	9	11		125 ± 3.0
Osmol	8	11		342 ± 6.0

Hypotonic fluids are indicated in situations where dehydration causes a relative increase in serum concentration of inorganic ions and an increase in osmolality. Since most birds that present to our clinic are also hypoglycemic , an ideal solution is to use 5% dextrose in a 0.2% sodium chloride solution. This solution has an osmolarity of 321 mos/liter, hypotonic to a normal bird's serum which ranges from 326 to 359 mos/L. Lactated Ringers and 5% dextrose in water are the fluids that have been most commonly used in our clinic. These fluids are isotonic to mammalian serum, markedly hypotonic to avian serum.

Unfortunately little is known about the acid-base balance and blood gases of avian blood. It is assumed that a bird in shock is suffering from metabolic acidosis due to hypoxia of tissues as is true for mammalian patients in shock. This will often self-correct once fluid balance has been attained. The total serum $C0_2$ can be measured by using the Harleco CO_2 apparatus*. This value is used to calculate the bicarbonate deficit. Usually, this test is not readily available so a suitable guideline is used: 1 meq/kg at 15-30 minute intervals, not to exceed a total of 4 meq per bird. The first treatment is given with an intravenous bolus. Sequential treatments should be given subcutaneously to avoid rapid changes in pH.

The total amount of fluids to be administered is evaluated on an individual patient basis. The general principle is to consider the state of hydration and degree of shock, maintenance fluid requirements, plus any ongoing fluid losses. Hydration is evaluated by using clinical signs of skin elasticity, PCV, and total plasma solids. Normally, a figure of 10% dehydration (approximately one total blood volume) is used to calculate the fluid volume to be administered. Using this figure a 1/2 kg hawk would require 50 ml of fluid to compensate for its fluid deficit. Maintenance fluid requirements are not generally available for birds but if one uses the 60 ml/kg/day value that is used for mammals, the maintenance requirement for this hawk would be 30 ml/day. Therefore, for a 1/2 kg hawk that is 10% dehydrated the fluid needs for the first day would be 80 ml.

*Harleco CO2 Apparatus, Dade Diagnostics, Inc. Aquada, Puerto Rico 00602

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THE GOOD SAMARITAN & THE LAW

By Donna Ialeggio '86

Virtually all wild birds are protected by state and/or federal law and it is against the law to keep most wild birds in captivity. In most cases, the young birds you "find" are neither abandoned nor orphaned and it is kinder not to try and "rescue" them. Distressed or injured birds may be assisted, but remember: unless injured or found near a dead parent, wild species should remain in the wild. Should you find and remove a bird from the wild you MUST, by law:

- contact an Environmental Conservation Officer immediately. If the animal recovered is of an endangered species, you must notify the Endangered Species Unit. (In New York State the number is 518/457-7484.) Your Department of Environmental Conservation officer will be able to provide you with the appropriate phone number.
- submit written confirmation of the capture within 24 hours.
- get a veterinarian's certificate within 48 hours. You are responsible for any veterinary fees incurred.

Federal law is quite specific with respect to the handling of migratory birds. Federal law (50 CFA 21 B 21.11) states: "No person shall take, possess, transport, sell, purchase, barter or offer for sale, purchase, or barter, any migratory bird and/or the parts, nests, or eggs of such bird except as may be permitted under the terms of a valid permit or as permitted by regulations in this part, or (the hunting regulations)."

Individuals may be licensed to handle wildlife species. A wildlife rehabilitator is an individual authorized by a given state to accept species for rehabilitation - that is, to return

Geese at Montezuma Swamp heading north from the D.C., Virginia areas.

Photo by David Grunfeld.

the animal to the wild. Failing this, the animal may be placed in the care of a public scientific or educational institution, for example a zoo. A federal permit is required to handle federally protected species.

The New York State Department of Environmental Conservation, Division of Fish & Wildlife -Special License Unit issues permits to rehabilitate wildlife. They emphasize that "The permittee shall take into account the best interest of the wildlife and the need to prevent harm to person or property as well as to prevent the spread of diseases among humans, domestic animals or other wildlife." Rehabilitators must immediately release to the wild in a suitable habitat any rehabilitated wildlife which appears capable of fending for itself. Certain species must be released as directed by the Regional Wildlife Manager. And again, a federal permit must be obtained to handle federally protected species. In addition to keeping a log and housing wildlife suitably, rehabilitators must comply with all applicable Federal, State and local laws, and non-compliance may mean immediate revocation of the permit. Wildlife held under this permit shall not be publicly displayed.

For more information, send for the pamphlet, "If You Care. . . You'll Leave Them There!" by the New York State Department of Environmental Conservation.

"Emergency Treatment"
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According to Sturkie and other authors, birds are more tolerant to blood loss than are mammals and withstand a loss of 75% of their blood volume without suffering irreversible shock. It is also true, however, that 75% of a 1/2 kg bird's blood volume is only 30 cc - a very small volume to lose. Many birds arriving at the clinic with limb fractures have large subcutaneous hematomas and extremely pale mucous membranes and can be assumed to have suffered a significant blood loss.

Both oral and subcutaneous fluid therapy are very frustrating means of administering fluids to a patient in shock since the volume that can be tolerated is less than that which is usually required. Also, the uptake of fluids into the general circulation is severely limited by the peripheral vasoconstriction present during shock.

Intravenous fluid replacement is an important part of the therapy for any animal that is in shock. The basic problem of administration of intravenous therapy to birds is one of logistics and restraint - a problem which has been partially solved by using a sling. The sling which we have used has been designed by Kay McKeever, author of Care and Rehabilitation of Injured Owls. The sling has the advantage of restaining the bird while allowing it to remain in a normal position and to exercise limited movement. A 22 gauge 1 ¼ inch Abbocath catheter may be inserted into the cutaneous ulnar vein at the elbow joint and fixed into position by tape. With the bird restrained in a body stockinette and placed in the sling, a slow continuous fluid administration is possible. The catheter should not be left in longer than absolutely necessary because of the stress caused by the restraint. Continuous intravenous fluid therapy is very helpful in the obtunded patient, but many birds will not tolerate the sling even in their debilitated state. The bolus intravenous method is helpful because it minimizes handling time, and decreases the stress of the therapy itself. Theoretically, large amounts of intravenous fluids given in a short period of time can overwhelm the cardiovascular system and create tissue edema. Studies in dogs and cats have shown them to tolerate fluid loading at rates of 20-90 ml/kg over a 10-30 minute period. Avian patients can receive 30 ml/kg by bolus over a 3 minute period with no untoward effects. An effective way to deliver the amount of fluids required is to calculate ½ of the dehydration deficit, plus the 24 hour maintenance and divide this into 30 ml boluses given 4 times in the first 24 hours. Over the next two days the bird receives its daily maintenance plus the remaining deficit. The bird's appetite usually returns rapidly after restoration of normal blood glucose concentrations. After signs of dehydration and shock dimish (at least 24 hours) food can be offered in the form of skinned and cut-up mice or chicks (taking care not to allow the bird to over-eat.)

In addition to fluid therapy, dexamethazone sodium phosphate at the dosage of 4 mg/kg should be given intravenously as a part of the shock therapy. Dexamethazone can be continued intramuscularly, using 1 mg/kg/day if signs of head trauma persist. Using povidone iodine scrub, open wounds are gently cleaned (the use of alcohol should be avoided). Unstable and compound fractures should be gently returned to a near-normal position and stabilized by a combination of gauze, tape, or body stockinette. The antibiotic given to an injured raptor must be effective against gram negative organisms since Gram negative septicemia is a fairly common cause of death in injured raptors. Kay McKeever has reported that cultures and sensitivity tests done on owls in her project showed chloramphenical to be one of the most effective drugs against the common wound contaminants. Chloramphenicol is a commonly used antibiotic and is administered at a dose rate of 20 mg/lb three times daily. Intramuscular or intravenous administration gives fairly consistant plasma levels, whereas oral chloramphenical tends to have eratic plasma levels.

Unless a fracture needs immediate surgical stabilization to save the limb, it is advisable to wait until the bird is stable before attempting radiography or surgery.

As soon as possible the injured owl or hawk should be provided with quiet, darkness and warmth.

In conclusion, many birds of prey present with an old fracture and in a state of extreme cachexia, dehydration, and hypoglycemia with or without an associated blood loss anemia. A few simple, rapid diagnostic tests may provide useful information on the bird's state of hydration and prognosis for short term survival. Emergency intravenous infusion of a hypotonic solution of dextrose and electrolytes as opposed to gavage or subcutaneous fluid administration shows promise in increasing the chance of survival, even in seemingly hopeless cases.

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GUEST EDITORS for this issue of Avian Rounds are Dr. Joanne Paul-Murphy (COR. '82) and Dr. Christopher Murphy (COR. '83). Both are residents at the University of California, Davis. Dr. Christopher Murphy is a resident in ophthalmology while Dr. Paul-Murphy is working with Dr. Murray Fowler in zoological medicine.

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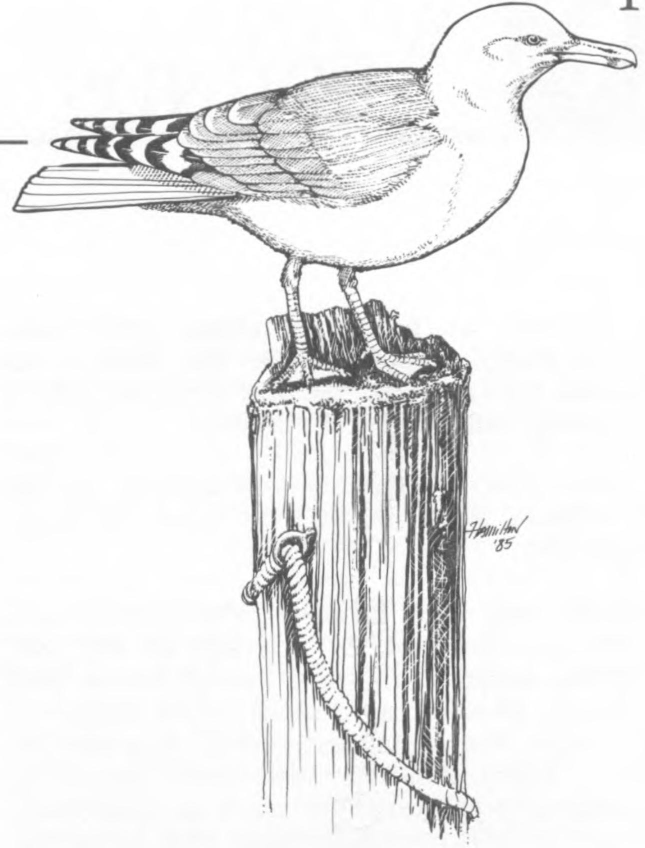

HEMATOLOGIC CHANGES IN CAPTURED WILD BIRDS

By Brad Taylor '86

The purpose of the research reported here was to demonstrate hematologic, histopathologic, and endocrinological changes that occur in healthy wild birds following capture and confinement. This information should assist rehabilitators and veterinarians working with wild birds to determine whether observed hematologic and microscopic changes are due to the stress of captivity or are the result of injury and/or disease.

This study was conducted at Shoals Marine Laboratory on Appledore Island off the coast of Maine. The herring gulls (Larus argentatus) are the most prevalent and uniform species nesting on the island and so were chosen as subjects. Wire mesh walk-in traps captured the birds and housing consisted of individual 4'x3'x4' outdoor wire mesh cages. All birds were provided with fresh fish and fresh water ad libitum. Veinipuncture of a brachial vein provided blood samples within 3 minutes of capture, 6 hours post capture, 1 day post capture and every 4 days thereafter for a maximun of 28 days. Hematologic parameters measured included packed cell volume (PCV), Total Plasma Solids (TS), White Blood Cell Count (WBC) and White Blood Cell Differential. Mean base line values measured from blood samples taken at the time of capture were as follows:

(N=16)
PCV - 49%
TS - 4.9 gr/dl
WBC 15,700 cells/mm^3
WBC Differentia -
- Heterophils - 9900 cells/mm^3
- Lymphocytes - 5200 cells/mm^3

The PCV dropped precipitously during the first 6 hours of captivity and then continued to fall at a slower rate throughout the period of captivity. This unexplained anemia corresponds with similar clinical observations of various species and numerous cases at the New York State College of Veterinary Medicine Avian Clinic. In this study, total plasma solids also dropped acutely (although insignificantly) and then returned to control levels by 1 Day post capture and remained at control levels throughout captivity thus indicating that red blood cells and not whole blood were being lost from the peripheral circulation of these birds. Blood loss due to trauma and sample collection was minimal during the study and could not account for the drop in PCV.

White Blood Cell concentrations paralleled heterophil levels due to the preponderance of heterophils in the differential count. This included a sharp rise by 6 hours post capture followed by a transient decrease around Day 8 and then increased levels for the remainder of captivity. The concentration of lymphocytes dropped sharply during the first 6 hours of captivity and then slowly returned to normal over the next 28 days. Monocyte, eosinophil and basophil levels were unchanged.

Necropsies and microscopic examination of all tissues were performed in randomly selected birds at varying intervals post-capture. As soon as 4 Days post capture, birds displayed the following microscopic lesions: severe diffuse amyloidosis in the arteriolar walls of the spleen, liver and kidney; vacuolization of catecholamine producing cells of the adrenal glands and decreased pectoral muscle mass characterized microscopically by moderate separation and edema of interfibrillar spaces. All lesions became more severe with increased time in captivity.

Plasma corticosterone levels were measured by radioimmunassay for all blood samples. These measurements revealed a dramatic increase in plasma corticosterone levels during the first 24 hours of captivity followed by a slow return over the next 16 days to values not significantly different from control values. The high corticosterone levels measured during the first day of captivity corresponded with observed behavioral distress in the birds (refusal to eat or drink and frantic attempts to escape from the cages) and with the transient lymphopenia reported above.

Conclusions:

Moderate anemia, leukocytosis with heterophilia and transient lymphopenia, severe amyloidosis of spleen, liver and kidney, severe decrease in pectoral muscle mass and vacuolization of catecholamine producing cells of the adrenals are reported here as consequences of the stress of captivity. The pathogenesis of these factors is unknown. However, high plasma corticosterone levels seen in this study to result from the stress of captivity or high catecholamine levels (not measured here), may be responsbile for the hematologic changes.

The above observations as well as clinical observations at the New York State College of Veterinary Medicine Avian Clinic suggest the following points: 1.) Anemia can be observed due to captivity and should be monitored. In long term patients, the effect of this anemia on the ability of a bird to survive in the wild should be taken into account when a bird is being considered for release. 2.) The changes in the leukogram are profound and may confuse or mask other causes of leukocytosis such as infection, trauma, inflammation or neoplasia. The clinical impression obtained at the New York State College of Veterinary Medicine is that extremely high leukocyte counts (greater than 50,000 cells/mm^3) usually indicates an infectious process. 3.) Total plasma solids do not change due to captivity and so losses in plasma proteins are probably attributable to some other process besides simple stress. 4) Clinical signs seen in captive wild birds may not result from observed histopathologic and hematologic changes. However, these changes may complicate the diagnosis and treatment of disease while in captivity and impair the ability of wild birds to survive upon their release into their natural habitat.

	PCV	Total WBC	Heterophils	Lymphocytes
0	49%	15,700 cells/mm^3	9,900	5,200
6hr.	44%	16,300	14,300	1,800
1 day	44%	15,500	13,300	2,000
4 d	44%	14,200	12,000	2,000
8 d	41%	13,300	11,200	2,000
12 d	41%	14,000	11,800	2,300
16 d	40%	17,700	14,700	2,900
20 d	37%	17,200	14,400	2,700
24 d	36%	19,800	16,400	3,200
28 d	33%	24,800	21,400	3,400

AN OWL IN THE CLINIC

A Report by Laura Smiley, '86

An immature Great Horned Owl (Bubo virginianus) was admitted to the New York State College of Veterinary Medicine Avian Clinic in February 1984. His down and lack of adult feathers indicated he was approximately one month old. He had been found, unable to fly or walk, on the ground underneath a nest with a rabbit's leg tendon wrapped around his leg. Although he was generally healthy, radiographs showed he had a compound comminuted fracture of the right tibiotarsus. The first step in the recovery process was supportive care including antibiotic therapy. Veronkia Kiklevich, a 4th year DVM student, surgically repaired the fracture with the insertion of an intramedullary pin to stabilize the fragments. The leg was then wrapped in a supportive bandage. While any neurological damage might leave the limb useless, in such a young bird, there is also great concern about damage to the growth plates.

For the next two weeks the owl was kept at the Clinic, then when recovery seemed to be progressing rapidly, he was sent out to the Laboratory of Ornithology to begin his rehabilitation. One month later, the recheck radiographs showed encouraging signs of healing. Six weeks after the surgery radiography confirmed a completely healed fracture, and the pin was removed. The owl now had full use of the leg, with no signs of impaired growth or neurologic dysfunction in the leg.

At the Laboratory of Ornithology , the owl was kept in a flight cage and continued to improved. His adult plummage came in nicely and he flew and used the foot well. Given live prey, he developed hunting skills quickly, learning to catch and kill prey. Any fears that the owl might imprint on its human handlers were also allayed ; he remained quite wild throughout his captivity reacting apprehensively whenever people came into sight. Finally, after being officially banded, the owl was released September 1984 on top of nearby Snyder Hill Road, a little over a mile from the College.

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