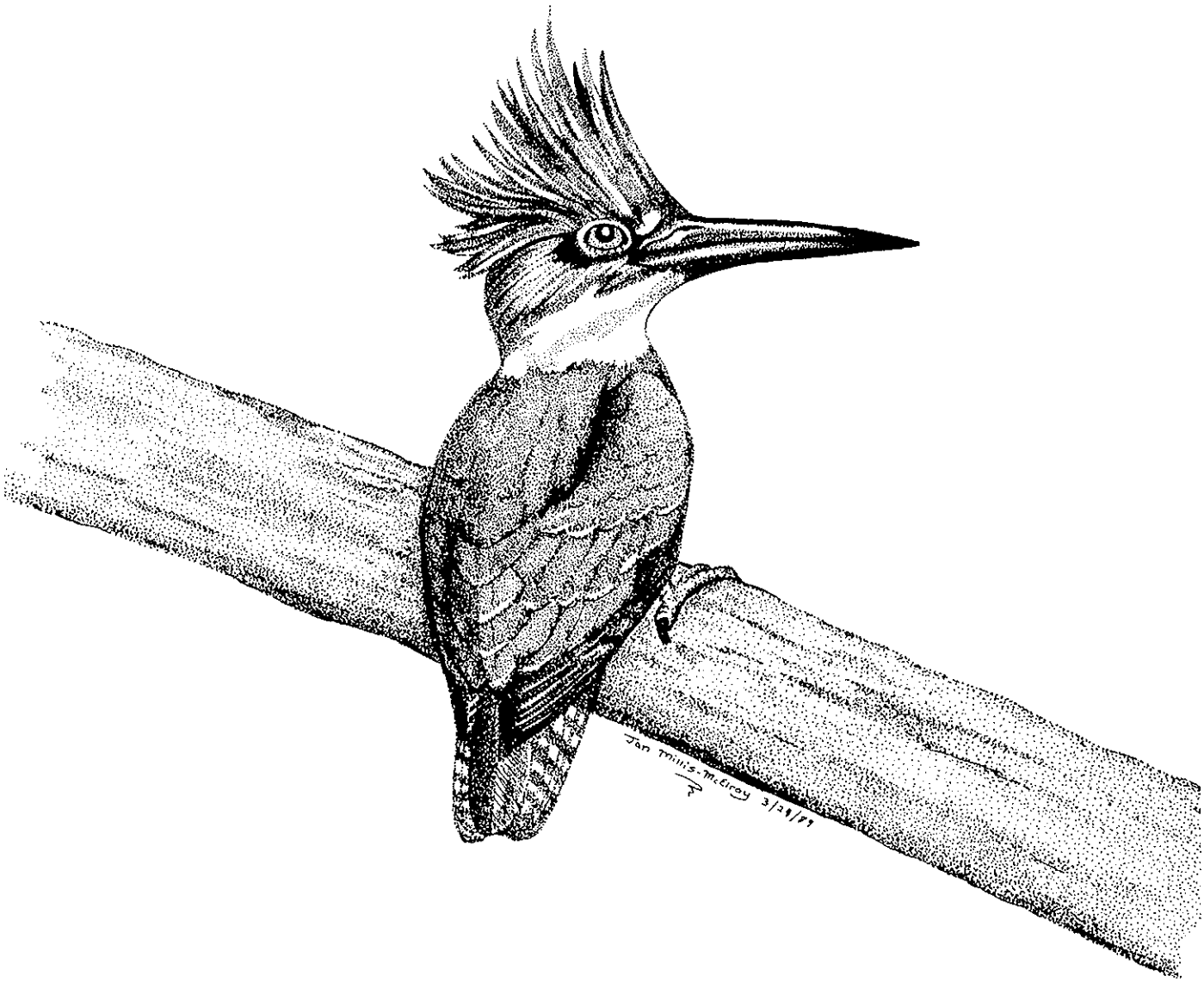
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WILDLIFE JOURNAL

Journal of the International Wildlife Rehabilitation Council



Kingfisher Rehabilitation Notes ..... Page 9

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Features

Alaska Oil Spill Bird Rescue Efforts
Jay Holcomb, IWRC President
International Bird Rescue Center
Berkeley, California 3

Physiological Assessment of Rehabilitated Raptors Prior to Release
Susan B. Chaplin Ph.D, Lori R. Mueller, and
Laurel A. Degrenes, DVM
Dept. Of Veterinary Biology,University of Minnesota
The Raptor Center, St. Paul, Minnesota 7

Rehabilitation Notes: Kingfishers
Loretta Torsey
Wings of the Dawn Bird Sanctuary
Antrim, New Hampshire 9

Departments

Editorial 2
Bird Banding Survey Request 13
Letters 15
Book Review 16
Literature Sale 19

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Editorial . . .

"Wanderings"

Charles J. Sedgwick



As I proceeded through my senior year in veterinary school, I was fortunate to have been allowed by my school to spend a total of six weeks at two other veterinary schools with wildlife rehabilitation programs. Additionally, I tacked on two weeks of holiday break time and wandered about the USA. While I learned a lot about wildlife medicine, I'll bet I learned more about the way things work, generally.

I started my journeys in October and November by attending the Raptor Research Foundation (RRF) conference in St. Paul, Minnesota, and then spent three weeks at the Raptor Center at the University of Minnesota. While there I also visited the other wildlife care facility (WRC) on campus operated by the veterinary students and Dr. Linda Wolf. In the spring, I flew to Boston and then traversed Massachusetts to North Grafton and spent three weeks at Tufts Veterinary School with Drs. Charles Sedgewick and Mark Pokras. While there, I attended a one day state meeting they sponsored and got to meet with rehabbers from that area. I spent about four days in New Hampshire visiting Wings of the Dawn Sanctuary as they were constructing their new facilities and flew to St. Louis to attend the annual NWRA Board meeting in March. There, Jay Holcomb, IWRC President, and I spent an evening touring the Missouri Wildlife Rescue Center, attending a party thrown in our honor by their wonderful volunteers, were the guests of the director, Suzie Sutton and her husband Al, for dinner and great stories about life in wildlife rehabilitation. Jay returned to California, only to get called to Alaska to deal with the worst oil spill in our country's history while I wandered off to Florida for Easter break. A week was spent at The Conservancy in Naples, while taking short trips to Sanibel Island (to visit C.R.O.W and staff) and to Miami, where I spent an afternoon at Kindle Animal Hospital with Don Harris, D.V.M., and Dave Hitzig from the Tropical Audubon Society, which operates a wildlife rescue clinic.

I learned a lot in my travels this year. Some of what I found will be written by various authors into articles of one sort or another in upcoming journals. Some of it can be passed on or communicated in the framework of the editorial and I will do so in this issue and in the next (Summer '89).

One of the general things that struck me most was simply the amount of information sharing that was available. What was also exciting was that knowledge was being shared in both directions, feeding off each source and evolving and adapting to the site where applied. While I learned some veterinary skills like the new bone cement teflon pin procedure and IM pinning of the avian coracoid, much of what I learned was simple and very useful.

In Minnesota, I heard Dr. Laurel Degrenes give a paper at the RRF on new uses for a skin dressing (Tagaderm ™ from 3-M Company) which sounded interesting. Upon spending three weeks at the Raptor Center observing the results, I have became a Tagaderm™ enthusiast

Continued on page 14

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Alaskan Oil Spill Bird Rescue Efforts

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Introduction

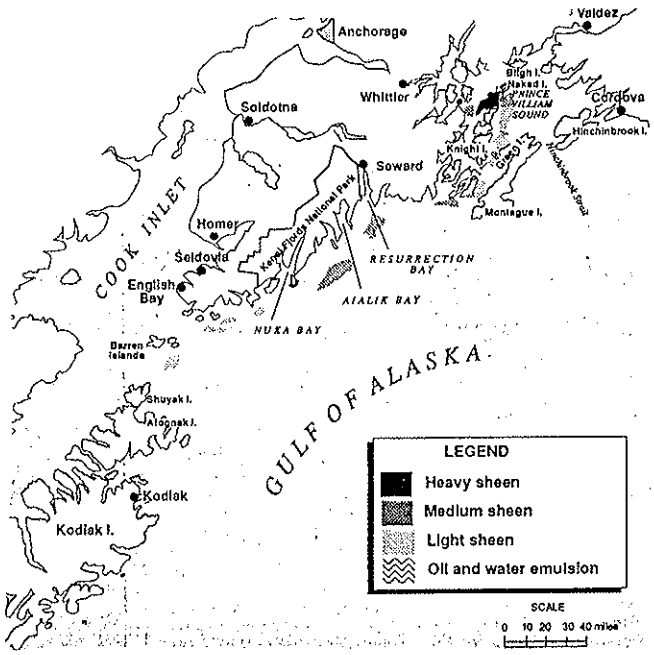
We affectionately call this "the oil spill from hell". Everything that could go wrong (weather, acts of God, human error, etc.) has gone wrong and the consequences have been suffered by all. It has been an incredible emotional strain to witness this level of environmental destruction.

It all started on March 24th, 1989, when the Exxon tanker "Valdez" hit a reef and spilled 11 million gallons of Alaskan crude oil in Prince William Sound. The oil was boomed around the tanker but on the third day high winds, common to the area, dispersed the oil to the northwest. International Bird Rescue and Research Center, on a response contract with Alyeska for disasters, was called into action to organize a rescue and rehabilitation program for affected birds. Director Alice Berkner of Vancouver, Washington, and Associate Director Jay Holcomb of Berkeley, California, quickly pulled together their oil spill response team and were in Valdez within 24 hours.

Prince William Sound is a particularly sensitive ecological area due to the high summer breeding population of seabirds. Large populations of resident Bald Eagles are also found here. Additionally, there is a stable population of Sea Otters and other marine mammals such as Orcas, Steller's Sea Lions and Harbor Seals. This is a wilderness area, sparsely populated and accessible mainly by air and water. While reported daily on the national evening news, the average person will have a hard time perceiving the vastness of this area or the scope of the spill. There are many islands and bays, some so small that they are uncharted, with shore lines that range from sheer cliffs to long gravel beaches. To give one a sense of how much shore line was fouled, the 1400 miles of affected beach and rock is a distance roughly equivalent to the coastline area from Boston to the tip of Florida. All this in late winter with snow on the ground and winds at times up to 80 miles per hour.

Setting Up the Bird Care Facility

Our responsibility was not only to set up a facility to care for the birds, but also to organize a major search and rescue effort. A vacant dormitory was located in Valdez and quickly converted to house the bird rescue center and the otter rescue effort. Due to advanced planning, basic bird supplies were already stockpiled at the Valdez oil pipeline terminal. This enabled us to quickly mobilize the facility. We were at limited operational capacity within 48 hours. While basic supplies were on hand, additional materials were difficult at best to acquire. Valdez is a seven hour car trip from Anchorage and can be approached



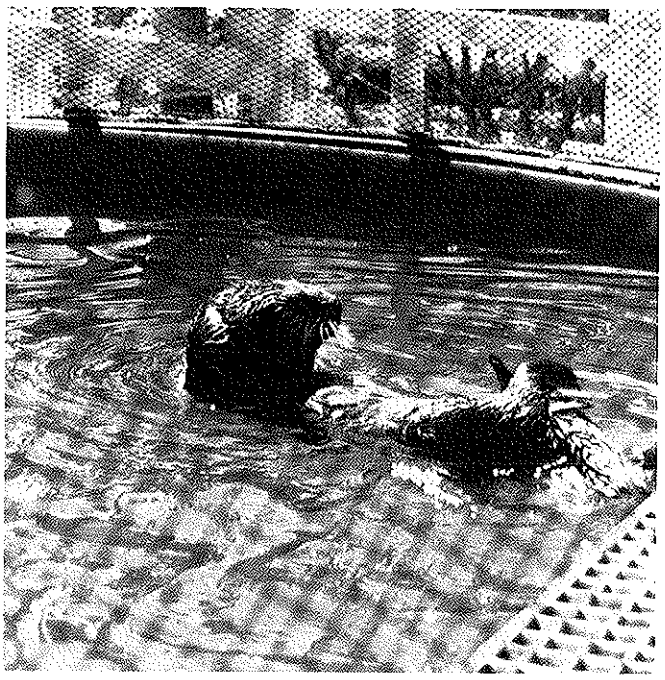
Oil contamination sites and areas of Search and Rescue efforts.

by air only when the weather permits. With the influx of international media and associated oil response personnel, the logistics of acquiring housing and rental cars quickly became an impossible task. This became yet another factor in our rescue efforts. In fact, the logistics of acquiring needed water softeners and similar equipment became the most frustrating challenge in the early days following the spill.

Search & Rescue Efforts

With the facility established, our focus changed to the problems related to capturing affected animals. In other oil spills birds, generally beached themselves in areas that were frequented by humans. In this situation, birds were beached on remote, isolated beaches and rock cliffs with little or no human access. Due to the amount of oil in the water and the cold temperature (39°F), many birds and animals were unable to make it to shore. The ones that did were particularly susceptible to depredation by Bald Eagles, Glaucous Gulls, River Otters and Red Foxes. For every one bird found alive, ten bodies were collected. Most of these bodies were eaten by predators with only skeletal remains to bear witness to their demise.

The initial efforts included five fishing boats which scouted the sound to determine the feasibility of search and rescue efforts. About twenty five Alaskan personnel were employed in this effort. Search efforts were begun and to our horror, we found pristine beaches covered up to one foot deep in crude oil. Helplessly, we watched birds flying into the bays, begin bathing, then struggling, only to succumb to the extremely cold temperature of the water. Our first Sea Otters were found high up along the beaches thirty feet from the tide line, grooming vigorously to extricate themselves from the oil. Most were easily approachable as they are awkward on land. However, the hazard to the handler was considerable since the oil made traversing the rocks very difficult. In addition, frequent snow flurries inhibited our visibility and chilled rescuers and animals alike. The otters were quickly scooped up with fishing nets and housed in the boat hulls overnight. Our efforts were frustrated by resident Bald Eagles who frequently swooped down to snatch sea birds before we could get across the rocks to them.



Mimi Wood

Sea Otters using the bird pools for waterproof checks.

We spent three days at sea (two traveling and one collecting animals). Our efforts netted nine Sea Otters and fifty sea birds (Pelagic Cormorants, Common Murres, Red-breasted and Common Mergansers, Harlequin Ducks, Barrow's Golden-eyes, White-winged and Black Scoters, Common and Arctic Loons, and Red-necked Grebes).

Based on the results of this pilot trip, a continuing program was set up and operated. The search and rescue responsibilities were 1) to collect live animals 2) to pick up dead animals in order to prevent secondary poisoning in predators, and 3) to scoop up oily debris through which bears and foxes scavenge for carrion, as well as kelp, which Black-tailed Deer eat as winter forage.

As the oil spread and began to move up the Gulf of Alaska, it became necessary to set up additional search and rescue efforts and care centers. The next search and rescue effort was centered in Seward and covered about 500 miles of extremely rugged coastline along the Pacific Ocean. The Chiswell Islands and adjacent cliffs were part of this area and are a primary breeding area for millions of seabirds including Tufted Puffins, Horned Puffins, Black-legged Kittiwakes, Red-faced Cormorants, Common Murres, Thick-billed Murres, Kittlitzs Murrelets, and many others.

The oil continued to spread, and search and rescue efforts were begun in the Homer area and off Kodiak Island. In Homer, animals were stabilized and shipped to Seward for further care. Another facility was set-up in Kodiak to clean and release birds. Eventually, activity in Valdez subsided and currently birds are centrally housed in the center at Seward. Transport of birds was very difficult due to extreme sea and weather conditions and distance between ports. Birds were flown between locations at various times by helicopters and fixed wing aircraft. All together some 125 fishing boats with zodiacs and about 500 people were hired in the search and rescue efforts.

Otter Efforts

The otter rescue effort was supervised by the U. S. Fish & Wildlife Service. Randy Davis of Sea World in San Diego was hired to organize and coordinated the Sea Otter project. Rehabilitation facilities were set up in a Valdez school gym and a mobile facility was eventually designed in Seward. During the interim period, otters were rehabilitated in bird pools in Seward. Animals cleaned and in good condition are currently housed in fishing net pens placed in the bay near Valdez and Homer until deemed releasable by the U. S. Fish & Wildlife based on the oil still in the area.

Four orphan pups are presently being held and two have been transferred to the Monterey Bay Aquarium where Sea Otter young have been successfully raised. This was a particularly sensitive time as the otters were just entering their pupping season and continue to bear live young in the rehabilitation facilities.

As of June 3, 1989 there have been307 Sea otters presented live for care, 21 have been released, 158 are currently being held in water pens in a bay, 92 have died in captivity, 5 have been euthanized, and a number have been transferred to other aquariums in the United States.

Continuing Rehabilitation Efforts

To date, 935 birds have been retrieved for care. Of those, 300 have been released. Seven Bald Eagles have been transferred to other facilities for further care. About 100 are presently in-shelter with the rest having died or been euthanized. The first animals captured and presented for care were suffering directly from the toxic effects of the crude oil. Birds and otters were noted to have hemolytic anemias with extremely low packed cell volumes. The otters were suffering from pneumonia and stress, and the necropsies on the animals showed kidney and liver damage directly attributable to the oil. This adverse impact on the initial survival rate.

Later in the spill, the victims were presented with less oiling but more debilitation, dehydration, and emaciated. Some of the birds had little or no oil on their feathers but were not waterproof. It is suspected that they had been exposed to oil sheen (the breakdown products of oil). Because the area is at the end of the migratory route for many of these birds, they are arriving thin only to be further stressed by the environmental disaster. Additionally, concerned citizens and rescuers are finding birds who are in need of assistance but are not oil contaminated and are presenting them for care.

One of our problems here has been the hardness of the water. The levels of calcium carbonate in the fresh water interact with the detergent and precipitate, interfering with the essential alignment of the feathers. This prevented cleaned birds from being waterproofed and delayed release. Water softeners are required when hard water contains high enough levels of such minerals. Once they were in place, the bird rehabilitation efforts were more successful.

Mimi Wood



Researcher Barrie Todd takes blood from an oiled Bald Eagle to assess the impacts of crude oil on the bird internally.

Bald Eagles oiled and secondarily poisoned by eating oil contaminated wildlife were presented for nursing care and cleaning. It was feared that many eagles would perish directly from the effects of eating contaminated carrion, however, this has not been observed to date. Nesting for Bald Eagles is currently beginning and biologists are noticing egg hatch failures. This is likely due to a variety of factors yet to be studied, but it is known that nesting failure will occur when the brood patch is slightly contaminated with oil, making incubation difficult. Further, embryos absorb oil through the shell.

Research Efforts

The International Bird Rescue and Research Center is continuing coordination with Dr. Michael Fry, an avian researcher from the University of California in Davis studying the toxic effects of oil . This project is a continuation of efforts begun at a San Francisco spill in 1985. Several papers have been published regarding this research (*Wildlife Journal* Vol. 10 #3, IWRC Conference Proceedings 1988) in this journal and elsewhere. Valuable rehabilitation information has been gleaned directly from this work.

Current efforts include toxicological studies on organ tissues of dead birds, and hematological studies on samples from live birds. It is felt that much new information will be gained from the on-going research efforts for both the birds in the spill and for the future.

Mimi Wood



IWRC Board Members Curt Clumpner and Jay Holcomb checking a wash job on a Tufted Puffin.

Politics of the Spill in the Last Frontier

Several ingredients have combined to formulate the working politics of this, our worst spill ever. We have all been operating under the assumption that if we had a major spill in Alaska, the technology and personnel would be able to both contain and clean it up. The oil industry conveyed that the risk of this magnitude of disaster was nil and maybe it was, statistically—but it happened and that has angered Americans both near and far. This, on a local level , has complicated efforts to clean up the environment and handle the rescue efforts. There are many agencies with jurisdiction that have been thrown together in this time of crisis and expected to oversee the environmental clean up. Not always have they worked well together or with the people who are trying to save the wildlife. The net result has been an escalating bureaucracy that has often frustrated those who are attemping wildlife rehabilitation here. For example, the red tape has hampered the procurement of the supplies, boats and workmen so vital to the crisis efforts. The main conflict revolves around adoption of the crisis mentality versus wading through myriad forms. The animals, shivering and wet, cannot wait two days until the company schedules another employee safety lecture. The net result has been less than expected efficiency. Flexibility and improvisation are essential in times of crisis. If the animals can't wait two days for a lecture, one rearranges the schedule so lectures are given daily at noon.

Rehabilitation Efforts as Reflected in This Spill

Major media attention has been focused on this spill. One thing that has come across clearly is that the media still had no clear idea what the rehabilitation component of this effort was. Over and over, they ask, "Are you a biologist, or a scientist?" The skills we brought to this spill were unique and vital and yet not recognized. Over and over, the press needed to be told what a wildlife rehabilitator was and what contributions we were making in this massive effort. Yes, we had scientists and veterinarians working with us to facilitate our efforts but the main work of the day was to return wildlife to the environment using the best medicine, technology, nursing and husbandry care, and rehabilitation experience.

How This Spill was Different from Other Coastal Spills

This rugged area is not near any population centers; in fact, much of it was accessible only by air or sea. The sheer volume of oil was bigger than any previous American spill and the impact on a pristine wilderness has been devastating beyond comprehension. This is not going to be cleaned up any time soon and certainly not before the winter. More agencies are involved in trying to regulate this clean-up than ever before and it is a situation within which it has certainly been complicate to try to function.

This is a spill in the breeding season where millions of beautiful birds are certain to be adversely affected. Much specific information will be gathered, compiled, and used in the consideration of future drilling efforts in the United States. Controversial proposals currently before Congress requesting permission to go into the Arctic National Wildlife Refuge for oil exploration are likely to meet intense scrutiny and more opposition.

Never in the history of oil spills have so many scientists and associated professionals descended to document and study the effects of the disaster. Neither has an oil spill or its rescue efforts gotten such media attention from both national and international press. We wonder if oil spills will ever be the same again.

All the animal rescue efforts have had complete financial support from Exxon. This has certainly not been the case in other spills even when the liable party was known. The search and rescue efforts were new to this spill and were financially supported by Exxon. In fact, the Exxon people have been willing to fund any necessary function of the rehabilitation effort.

Never before have so many Sea Otters been oiled. This has been especially alarming to Californians who have such a limited population and worry about a spill along that coast line. The population of

Continued on page 13

Physiological Assessment of Rehabilitated Raptors Prior to Release

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Introduction

About 4500 raptors have been treated at The Raptor Center (TRC) at the University of Minnesota for a variety of injuries or medical problems since the inception of the program in 1972. The average time spent by raptor patients in convalescence and rehabilitation at TRC is 10-12 weeks, but some birds have remained in the clinic for six months to a year before release. After the prolonged period of cage rest, there is a noticeable decline in their fitness and stamina, as would be expected in any conditioned athlete. One of the goals of the rehabilitation period is to assist releasable individuals in regaining their previous level of flight fitness by exercise. It is, of course, imperative that these birds be reconditioned to the level of performance of a wild individual; otherwise they will be inferior competitors for their natural prey, and will most likely starve.

Releaseable raptors are reconditioned in stages. Initially, an individual is placed in a large flight room which permits the bird to flex its long-unused muscles, extend its wings, and attempt short flights up to a high perch. Then the bird is "flown" between two perches at either end of a 85 foot corridor. Successive flights enable the bird to regain its aerodynamic balance, strengthen pectoral muscles, practice take-offs and landings, and encourage aerobic conditioning (see results and conclusions below). When the bird can make ten successive hallway flights easily and without extreme effort, it is "flown" outside in a large open space, on a creance. Successive flights of 100-200 feet aid in the development of endurance.

Certain behavioral and physiological responses to exercise are routinely monitored by TRC staff during the course of the exercise program. Some of the criteria for determining readiness for release are willingness to fly, ability to sustain flight and gain altitude, exhibition of normal range of motion in wings and legs, packed (red) cell volume of 40-45%, and plasma solids of 3.2-4.0 g/dl. These assessments may provide an index of "readiness" but they are subjective and are not a practical test of a bird's performance level.

Recently, we have devised a performance test for some of the common raptor species by exercising birds over a standardized course and measuring their blood lactate levels post exercise. We found that blood lactate levels peaked at 2 minutes and recovered to preflight levels within 10 minutes in a well-conditioned hawk, while a non-conditioned hawk exhibited much higher peak lactate levels that did not return to preflight levels within 10 minutes (Fig. 1). Accumulation of blood lactate in response to exercise reflects dependence on anaerobic metabolic pathways and thus indicates inadequacy of oxygen supply to working muscles. Race trainers have found that as fitness increases in thoroughbred horses with endurance conditioning, their aerobic capacity improves and levels of lactic acid produced during moderate to high levels of

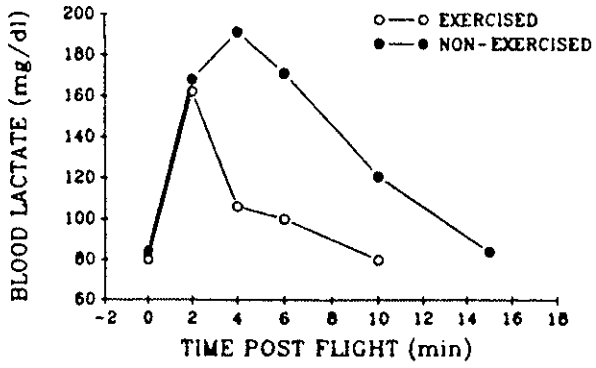


Fig. 1. Blood lactate concentration (mg/dl) of Red-tailed Hawks as a function of time (min) following standardized hallway flight exercise. Open circles are data from a well-conditioned bird, just prior to release. Closed circles are data from a captive, imprinted hawk that had been housed in a flight room but never exercised.

work remain relatively low (Persson, 1983). However, in non-conditioned individuals, the levels of lactic acid rise rather quickly at these same work levels, and eventually the acidotic condition of the muscle limits (or stops) the work.

In this article, we will summarize the results of the blood lactate response to standardized exercise in six Red-tailed Hawks, illustrate the relationship between severity of injury and progress in flight conditioning, and discuss the relationship of blood lactate and respiratory rate responses post exercise.

Methods

The hawks had been admitted to The Raptor Center for treatment and had been confined to cages for 3 to 30 weeks prior to beginning flight training. Once recovered, the birds were maintained in a large flight room measuring 18.2' x 9.9' x 9.9' (or 5.5 m x 3 m x 3 m) where they were fed rats, mice, or guinea pigs every other day.

The hawks were trained to fly the length of a 85 foot corridor that had free-standing perches that were 0.6 m high at each end. A total of ten flights were made, with 20 second rests in between, three times a week. Respiratory rates were counted at 1, 3, 5 and 10 minutes post exercise once a week. Birds were manually restrained in dorsal recumbency and blood withdrawn from the basilic or brachial vein at the appropriate time. Once the birds could easily fly ten lengths of the corridor, they were taken outdoors and flown on the creance, on days alternating with indoor flying.

Blood lactate was determined from whole blood, using the Sigma Lactate Diagnostics Kit. Whole blood (0.1-0.2 ml) was extracted with twice the volume of ice-cold 8% perchloric acid to precipitate protein (i.e., 0 .4 ml 8% perchloric acid for 0.2 ml blood). Samples were allowed to sit for 5-10 minutes on ice, after which they were centrifuged for 10 minutes at 2500 rpm. Blood samples are stable in the perchloric acid for two hours in an ice bath. The supernatant (clear) was pipetted off and refrigerated in a sealed and labelled tube until assays were performed. Samples can be stored in this way for 7-10 days.

The lactate assay was done per instructions in the Sigma Lactate Diagnostic Kit (No. 826-UV, Sigma Chemical Co.). Glycine buffer, distilled water, NAD, and LDH enzyme were added to 0.1 ml of the supernatant and incubated at 37° C (52 F°) for 30 minutes. Alternatively, to save reagents, one can dilute them with distilled water 1:1, and add 0.2 ml of supernatant to the mixture before incubation. (Bird lactate levels are much higher than other vertebrates for which the test was designed, hence one must either dilute the sample or dilute the reagents.) A blank of the buffer, water, NAD, and enzyme mixture with the same volume of 8% perchloric acid as the supernatant sample was also incubated. Immediately following incubation, the absorbance of the mixture was read at 340 (UV) on a Beckman DU 20 Spectrophotometer. Conversion of absorbance to mg lactate/dl blood was easily accomplished by multiplying the corrected sample absorbance (sample minus blank) by 65.1 (for 0.2 ml supernatant) or 130.2 (for 0.1 supernatant).

Body temperatures were measured during and following exercise in one Red-tailed Hawk by force-feeding a Model X-M temperature transmitter (Mini-Mitter Co.) to the bird before exercise. Blood was also taken from an additional two Red-tailed

Hawks 10 minutes post anesthesia with a Ketamine-xylazine (Rompun ™) mixture, in order to determine the basal levels of blood lactate in this species.

A Red-tailed Hawk that had been manned and was currently being used for hunting was flown over the standardized test course, in the same way as the rehabilitation patients. Blood samples were drawn at 2 and 10 minutes and lactate analyses were performed as described above. This individual represented our ideal endpoint of a physically fit hawk, and its lactate values post exercise were used as standards with which to compare the rehabilitated hawks.

Results

The 2 and 10 minute blood lactate levels of a falconer's hawk were used as standards for comparing the progress of the rehabilitated birds: 2 minute lactate concentration was 99 mg/dl; 10 minute lactate concentration was 47 mg/dl, and this value represents a basal level of lactate typical of a non-stressed, non-exercised state.

Continued on pg. 17

Rehabilitation Notes:

Handrearing the Orphan Kingfisher *(Megacryle alcyon)*

Loretta Torsey
Wings of the Dawn Sanctuary
Rd #1 Box 332 A
Antrim, New Hampshire

Introduction

The Kingfisher's rattle call is usually heard before the bird is seen. While it flies swiftly from one end of its territory to the other, a flash of brilliant blue will catch your eye as it calls again. The Belted Kingfisher is found throughout the United States and Southern Canada and as far north in the summer as the arctic regions. As the open waterways freeze in the winter, the birds move to the more southern states, Mexico and into northern South America.

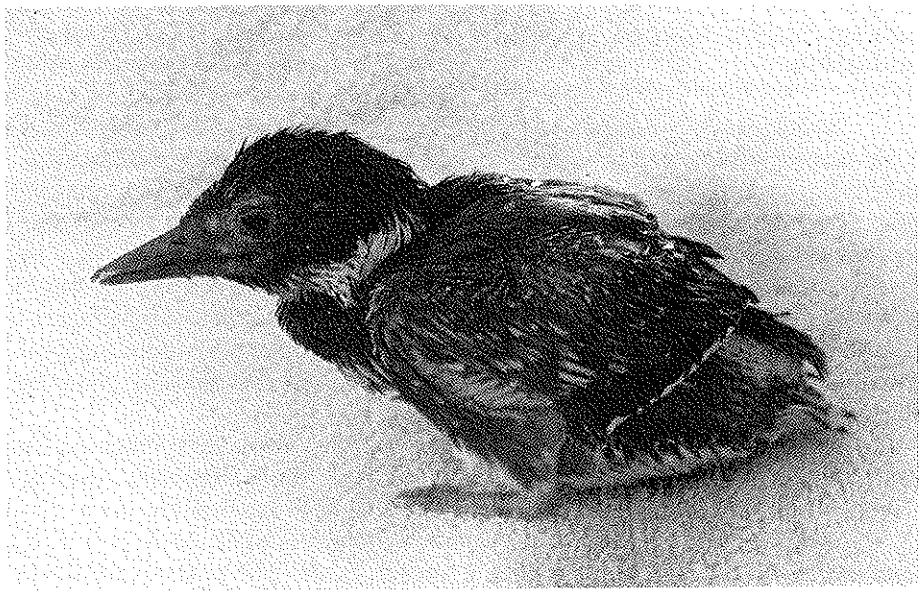
Their habit of nesting in burrows makes their nests easy targets for accidental destruction by humans and seldom does a summer go by when they are not presented to wildlife rehabilitation centers. Young Kingfishers are simple to raise successfully, once you understand their needs.

Adult Description

The large, crested head, and long, heavy bill, combined with short legs, and relatively small feet give the Kingfisher the look of being top heavy. They have a grayish-blue head, back, wings and tail, while the throat and lower abdomen are white. A grayish-blue band runs horizontally across the chest. Wing feathers have white spots and are white tipped, while tail feathers are narrowly barred with white. The female can be identified by a rust band across her chest, below the grayish-blue band.

Natural Diet

Small fish are the principal food of Kingfishers, although they will also feed on amphibians, reptiles, crustaceans and, in hard times, beetles, crickets, grasshoppers and mice. Kingfishers perch on a branch over the water watching intently for a fish to swim near the surface below. Once a fish is spotted, the birds dive head first into the water, disappearing from sight, seize the prey, and rise immediately from the water. They perch on a branch to eat their fish, usually snapping the head against the limb to stun it,



A young Belted Kingfisher in captivity.

then swallow it head first. They also will hunt by hovering in one spot with rapid wing beats, waiting for a fish to break the surface. The bones of fish and the hard shell of crustaceans are formed into a pellet and regurgitated when digestion is complete.

Territory and Courtship

Nest sites and fishing sites are the two important territories for the Kingfisher, and may or may not be the same place. The male arrives first, as early as March, and begins to defend a nest site. The females arrive a few weeks later and each pairs with a male. Their pairing seems to take place with little display and the pair remains together sharing activities throughout the breeding season.

Lakes and streams with good fishing may not have suitable banks for nesting and the Kingfisher will travel up to a mile from the fishing site for a nest site. A few weeks after the fledging phase of the young, the family breaks up and each finds its own fishing territory to defend. These territories are half the size of the breeding territories and are less than permanent, because when or if the water freezes, the birds will quickly move to a place where they can feed more easily.

Nesting, Egg-laying and Incubation

Nesting occurs at the end of a long tunnel whereever the Kingfisher can find an appropriate bank along streams, shores, oceans, or even man-made banks and gravel pits. Sandy clay soil is preferred and probe holes may be made to test the suitability of the soil. The nest site is clear of vegetation. Both adults do the excavating using their bills, and as one bird enters the tunnel, it kicks out the soil loosened by its mate's previous digging. The tunnel is 3-6' long, sometimes up to 15', slopes slightly upward, and is 3-4" in diameter. At the end of the tunnel is an unlined chamber 9-12" in diameter and 6-8" high. It takes 3-14 days to complete the nest, often severely wearing down the adults' bills. A dead limb is almost always found within 100' of the tunnel entrance. A telltale sign of the kingfishers' tunnel is two grooves at the entrance, worn by their feet.

The female lays 5-7 eggs, sometimes 8, and both parents take turns incubating them during the day. The female does the night shift, while the male perches on the limb outside. Incubation takes 22-26 days.

Newborns, Nestlings, and Fledglings

Hatchlings weigh 15-20 grams and do not have any feathers. The skin is pinkish except over the feather tracts, where the skin is very dark or black. They hatch with their eyes closed. During the first few days of life, the adult male provides the majority of the food. The parents collect food for the young, feeding every 20 minutes from 4 a.m. to 11 p.m. A volunteer described the hatchlings best as "proof of her dinosaur theory" and indeed they do look like tiny Pterodactyls.

By the age of one week, the young kingfishers' eyes are open, and the feathers appear in their sheaths, where they remain until 17-18 days of age, when all their feathers burst from the sheaths within 24 hours. Kingfisher nestlings do not expel fecal sacs. They eject their liquid feces high against the chamber walls and then peck the sides of the chamber, burying their feces under foot. They are born with a hard protective coating on their soft bills. This hardened tip protects them from injury while pecking, and is shed when the feather sheaths break.

Kingfisher fledglings can fly when they leave the nest. During the first few days of freedom, the young stay near the parents in protected places. The parents continue to feed them until, by the end of two weeks after fledging, the young are catching their own fish.

Captive Diet

The diet is fish, fish, and more fish. There are no substitutes. In the wild, the Kingfisher only eats other things when it can't get fish.

The best diet is to feed live fish 3" and under while in captivity, even to the day old hatchling. Cut the fish in small pieces and hand feed with forceps until their throat area appears full. Hatchlings should be feed every 20 minutes for fourteen hours a day. Nestlings should be fed every thirty minutes and fledglings once hourly.

When feeding larger fish to hatchlings, the fish must be pulverized. Once the head is removed, the blender does a good job of grinding bones very fine so they can be digested. The fish mush is fed in a 1cc syringe. The birds gape readily, noisily bobbing their little heads. At the first signs of feather sheaths, start a gradual change to chopped pieces of fish. Use fish six inches or smaller so that the bones are small enough to be digested. Once the birds are completely changed over to a diet of chopped fish, start adding the heads which should be crushed at first introduction. Just let common sense be your guide. The young birds will begin casting pellets by the time their feathers open.

For most rehabilitators, getting live fish is difficult because of a lack of funds or time-consuming responsibilities for other creatures. Some of this burden can be relieved by feeding dead whole fish until the young birds fledge, after which live fish must be fed until the Kingfishers are released. Go to the local fish hatcheries early in the spring for their culls and freeze them. Get as large an amount as they will donate. Thirteen Kingfishers raised by the author during 1988 ate on the average twenty 5" trout a day.

There are two ways of getting live fish: cheap and time-consuming or expensive and easy. The

first way means trapping your own. A Fish & Game permit is required and the local officer should be contacted for information. Minnow traps baited with dry dog food are used to catch the fish. Trap lines must be checked daily and rebaited. One word of caution: Throw back any Horned Pout (cat fish)--they can spike your birds and kill them.

Another source for live fish is buying them. The least expensive is through a wholesale bait dealer. Ten pounds of shiners will cost approximately $ 60.00 (1988 cost) and will contain about 700 fish. The price usually includes delivery and you might want to take advantage of this as they require refrigeration, something the dealer's truck has and your car doesn't.

Preventing Hypothiaminosis

A diet of dead fish must be supplemented with vitamin B1. Dead fish contain an enzyme called thiaminase which destroys thiamine. Birds with this deficiency may show "stargazing" behavior where their head is twisted so they are looking upwards.

It is easy to prevent this deficiency by giving vitamin B1 daily. The Thiamine dose is 10-20 mg/Kg of body wt. orally. Rather than calculating individual doses for each bird, time can be saved by weighing each individual from the clutch and averaging their weights. Calculate one dose and give orally to each chick. Be sure to average the weights at least daily as they require more as they eat and grow larger.

Fish Housing

To house live fish, set up an aquarium in the refrigerator. Yes, you read that correctly! Shiners require cool temperatures, 40-50 °F, so they can draw oxygen from the water. An inexpensive way to keep fish alive is to use a plastic 20 gallon garbage can, cut down to 18" high. This provides the minimum amount of water needed to keep ten pounds of shiners. A small air pump, an air stone and plastic tubing sufficient to reach the bottom of the can, will provide enough air circulation for the fish to breath. These items can be purchased from any pet store. Put the can on the bottom of the refrigerator where it cannot possibly collapse a shelf when full of water. Set the pump on the shelf above and let the air stone hang off the end of the tubing to the can's bottom. The pump's cord is run out through the door and plugged in after you have water in the can.

Your water may have a lot of nasty things (such as chlorine, bacteria, metals, or fungus) in it that will kill the fish. A bag of Baitsaver™ purchased from a bait dealer will take care of these problems and a hundred others also. This is an extremely worthwhile investment and, though it turns the water a lovely blue, Baitsaver™ is non-toxic to the birds.

If you buy live fish you can dump them, water and all, into your aquarium. If the water level is more than 4" from the top edge of the can, you will need to add more. It is wise to test the pH of both the water the fish are in and the water you want to add. If there is a large difference between the two, you will need to equalize the pH. This is very simple to do and most pH testing kits contain sodium bicarbonate and sodium phosphate for changing the pH balance. The ideal pH level is 6.8, slightly acidic.

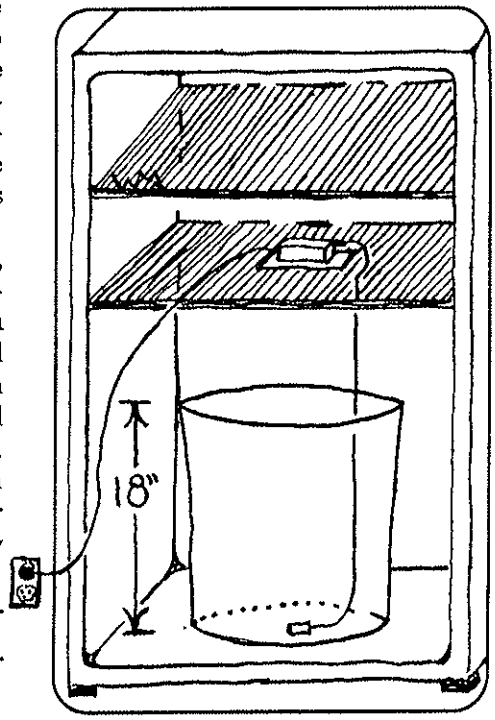
With fish you are trapping, set your aquarium up 24 hours before the fish arrive. Most likely you will have picked them up in a pail with water dipped from the stream you caught them in. Dilute the pail water in half with aquarium water. Put them in the refrigerator with the air pump and let them sit for several hours. Then you can safely transfer them to the aquarium.

Housing

Hatchlings require heat. An incubator or heat lamp will provide ambient heat. They also can be raised in butter tubs lined with paper towels, on a heating pad. Be sure to include a thermometer so you can monitor the temperature inside the bowl. By the time they weigh 100 grams, at around 9-10 days old, they can thermoregulate themselves.

The chicks grow quickly and can be housed in a variety of different sized laundry baskets, moving them to a larger one as they outgrow the one they are in. Line whatever cage you use with paper 18" up the sides to catch the ejected liquid feces. Keep the birds clean. If soil builds up on feathers, waterproofing becomes very difficult.

Once the feathers have unfurled, the juveniles weigh approximately 170 grams. It is time to move them to a cage which allows them to start perching and exercising their wings (3' x 3' x 3'). At this point start introducing live fish in a shallow bowl. The young birds will still want to be hand-fed but, by the end of two weeks, they will be self-feeding. Their weight will drop. Don't panic, this is normal and will level off at about 130 grams. Once they are completely self-feeding, they are



ready for a flight cage.

Kingfishers easily imprint on each other. As with all hand-raised birds, it is important to raise them in groups.

Release Preparation

Every essential behavior the Kingfisher needs is inherent, but in captivity the young birds do not have their parents to provide support until they become proficient fishers. The flight cage allows them to develop their life skills in safety.

The flight cage should be 24' long and at least 8' high. Whenever possible, use baffles to create longer flight patterns. Kingfishers will try to crash through wire when first placed in a flight cage. You can prevent injury by hanging sheets, tarps or blankets, or by lining the flight cage with soft netting. Flexible perches with a rough texture of carpeting or turf mats are best.

Now, it is critical to feed live fish only. The first pool should be small or you will find your birds dead from drowning. An 8" x 8" cake pan is ideal. Since fish cannot live without air, only place 6-8 fish in the pan at a time. Going to the flight cage every 1-2 hours to add more fish will not tame these birds. On the contrary, they will come to resent your presence more and more. Gradually increase the width and depth of the pan until they are diving in a kiddy pool. Provide a large rock at pool side for them to snap their fish against. Kingfishers are quite comical learning to stun their fish.

Kingfishers literally do not know how to come in out of the rain. When first put in the flight cage be sure to check them right away when it begins to rain. The birds will become hypothermic if they get soaked.

Release

The Kingfisher does not come readily to mind when thinking of birds of prey. He is, however, and as with any predator his physical abilities need to be at their peak. He needs to be able to fly full speed and land on a perch without slowing down, to stop in mid-flight and change direction, and to hover for extended periods. He should raise his crest, bob his head and/or tail, and call in moments of danger, as when you enter the cage.

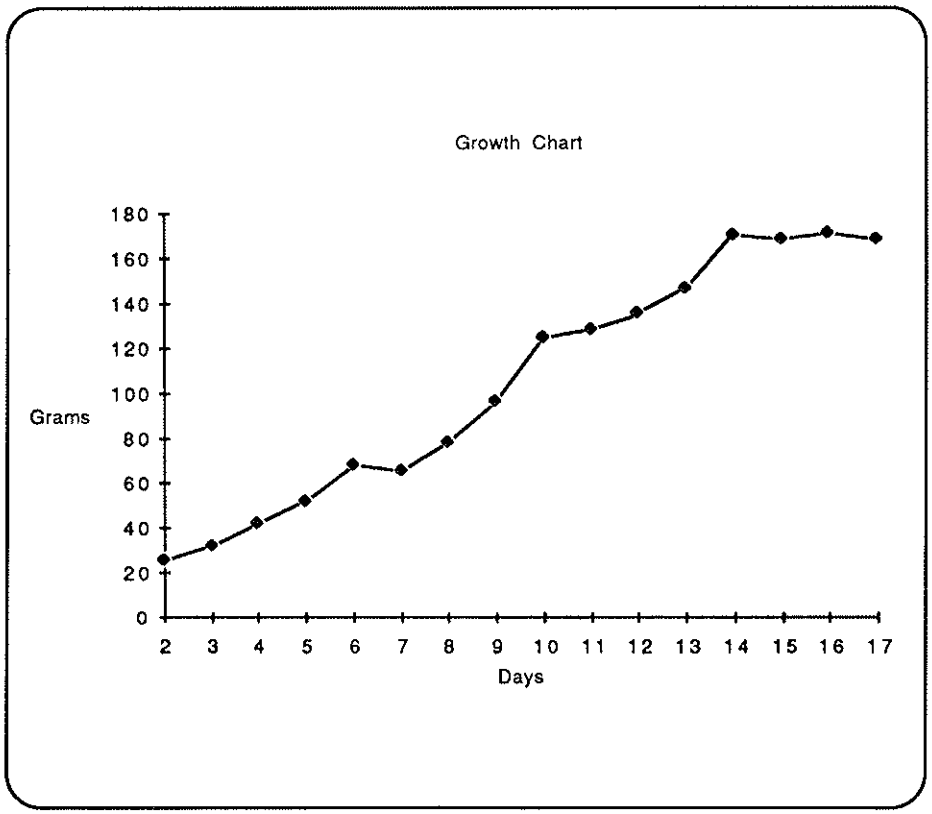
Also critical to their survival is waterproofing. They must be as waterproof as a loon or grebe. Like the latter species, they dive under water to catch food and there is increased pressure on their feathers as the depth of their dive increases. When they dive, they should come out of the water dry. Feathers should not be bent or broken.

When the Kingfishers are proficient fishers, waterproof, and physically conditioned, they are ready for release. Locate a site with plenty of fish, pollywogs, and crayfish but free of other Kingfishers. Established adults will quickly drive new birds out of their territory. Release early in the day, when the weather forecast predicts several good days. Take one last look, because when you open the door, they do not waste any time leaving.

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STOKES, Donald & Lillian. 1983. *A Guide to Bird Behavior Vol. 2.* Boston: Little, Brown, and Company. pp. 61-70.

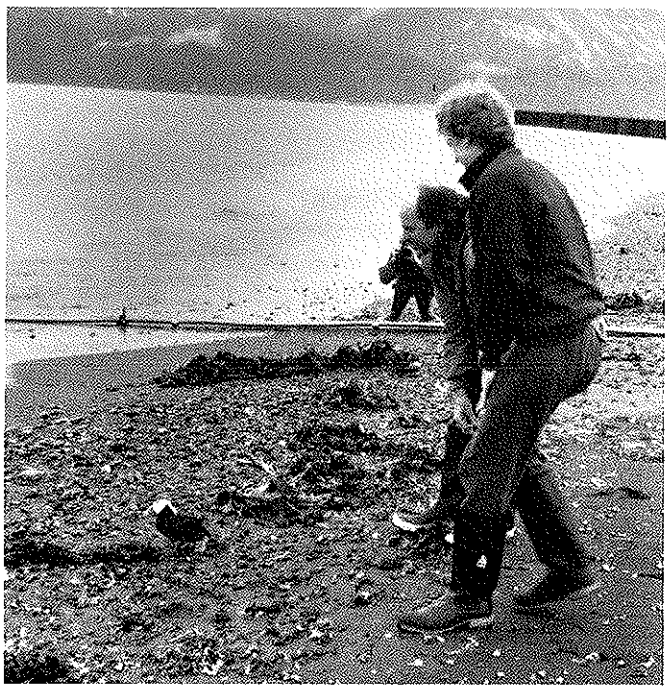


Continued from page 6

Alaskan Sea Otters was stable before the spill. The recovery of this population will be carefully studied for implications elsewhere.

Because of the dense population of Bald Eagles in this area of Alaska, there has been more secondary contamination than in any previous spill. Likewise, because of the dense population of sea birds that breed here, the potential for massive impacts both on this generation of birds as well as the next exists.

Mimi Wood



Rescue workers Patrick Grab and Jay Holcomb releasing a Tufted Puffin.

Summary

This really has been "the oil spill from hell." Everything from logistics to politics have made the day to day functioning on-the-job an exercise in intestional fortitude. As mentioned before, it has been an incredible emotional strain to witness this level of environmental destruction.

From the first day, we heard the concerns and received over 3,000 calls from people who wanted to help. We understand the frustrations, anger, and sorrow that you as rehabilitators have felt watching the media reports. Fortunately, we have an excellent response team and plenty of local volunteers whom we have trained to handle the birds.

The spill is a symbol of a societal ill that beckons us to refocus America. Like the birds sitting cold and wet, the environment can no longer afford to take a back seat in our priorities. We need to adopt a crisis mentality now. You as rehabilitators can help on a local level to focus attention on the crisis and generate the stimulus for further the examination of these priorities in your community. You can do more than you think. Please keep trying.

Bird Banding Survey

Concerns have been growing among wildlife rehabilitators for a need to band birds passing through our doors. Many rehabilitators have applied for new permits and have been turned down. Some may have also heard that the banding lab is not renewing permits for those who band rehabilitation birds. IWRC has been assured that this is not the case. Banding is an added way for the rehabilitator to understand whether our treatment techniques are successful. Other information gained includes a better understanding of the movement of those birds released, knowledge of those released related to breeding and raising young, and assessment of any given species census.

IWRC and NWRA (National Wildlife Rehabilitators Association) have formed a joint committee to look into the feasibility of having the banding lab issue permits to wildlife rehabilitators. In our communication with the lab we have explored their concerns in regarding this issue. They would like to know what species we want to band? What type of band markers do we want to use? What type of data are we looking to recover?

The banding lab is interested in further talks with our committee especially if we are willing to begin with targeting specific projects. IWRC and NWRA are asking our members to help. If you will take a few moments and complete the questionnaire we would appreciate it. Your support in this project would aid in our efforts to modify current regulations and or policies regarding the banding of rehabilitated wildlife.

Crystal Norris
NWRA/IWRC Banding Committee

extraordinaire (I only wish I owned stock in the company). The journal expects to publish a short article on this product soon, but I wanted to mention it here as it has marvelous potential for wound management. In fact, for some wounds, I think it may replace many uses for our present day human Band-aid™.

Tagaderm™ is a very thin plastic with paper guides to support it while being applied. It is selectively permeable to air to promote epithelialization of tissue but excludes other substances such as water, or dirt. Little or no granulomatous tissue formation (scab) is associated with this product. The wound edges stay well apposed with this wrap. It can be applied to feathers and leaves little residue to interfere with waterproofing. It covers wounds so well that pain sensors in the cutaneous nerves quiet down and people who use it on themselves wonder if it has a pain killer in it.

Less pain may result in less self-inflicted trauma in our patients. Tagaderm™ is clear and wounds underlying it can easily be observed without peeling it off. It can be left in place, depending on the wound type for 1-5 days which reduces the amount of bandage changes required so the animals are stressed less and rehabilitators save money in bandage materials.

The premiere uses for it are in superficial degloving wounds like those metacarpal scrapes, or the ones bunnies get when partially skinned by lawn mowers or cars. We are still trying it on different types of wounds, surgical sites, etc. and will get back to you.

Okay, you say, so what is the flip side? Well first, it isn't cheap. A box of 100 (Size #1625) costs about $50--but they can be cut them in half for small wounds which makes them about 50¢ each. Secondly, they probably could harm an animal if used to cover infected or improperly debrided wounds. And third, they seem to hold too much moisture in reptiles, especially turtles, and may not have as much use in this type of animal (See"Reptilian Surgery Part 1 Basic Principles" in *The Compendium* , Vol. 11, No.1).

As we try it more, we will learn more of its values and pitfalls and will share that with all of you. Meanwhile, we are interested in hearing from you regarding your experiences with this product or similar ones like Opsite ™.

Another thing I learned included a simple tip on wing wraps. The Raptor Center staff insists that all their birds be wrapped with a white gauze before applying the Vetrap™. They have found fewer problems with patagium contraction and hyperextension of wing joints by zealous rehabbers when the gauze is placed in the figure eight wrap pattern before the Vetrap™. After looking at their birds and mine, I decided that they were right.

These are just a couple of the things I learned in my wanderings -- simple things that make a difference in the quality of animal care. It seems to me that we could use a regular feature on this sort of thing--so we will give it a try. Let us know if you have something to share with us.

More on my perambulations and learnings in our next issue. -Jan White-

IWRC Conference 1990
Washington, D.C., October 19-21st
First Call for Papers

The conference committee is seeking rehabilitators willing to share their knowledge on a large variety of topics: from squirrels to javelina from gold finches to Golden Eagles, from computer programming to how to get 120% from each volunteer. *And* just a little food for thought, how much time do you spend educating each animal's finder? Does our responsibility go any farther than the bird in the hand? For further information, contact Jonolyn McCusker at 2615 E. Arroyo Chico, Tucson, AZ 85716 (602) 326-9248.

Letters to the Editor

Dear Editor:

I read with interest Janna Wynne's article on Avian Haematozoan Parasites. It was informative and I think will be beneficial to many rehabbers. If people wish more information on haematozoan parasites then there are two other publications that might be of interest: **A Host-Parasite Catalogue of Avian Haematozoa** by Gordon Bennett, M. Whiteway and C. Woodworth-Lynas and **Bibliography of the Avian Blood inhabiting Protozoa** (plus supplement) by Gordon Bennett, J. Kucera, C. Woodworth-Lynas and M. Whiteway.

The cost is $15.00 (Canadian funds) and $2.00 (Canadian) (supplement $1.50 Canadian) respectively and they both are available from: The Department of Biology, Memorial University of Newfoundland, St. John's, Newfoundland, Canada A1B 3X9. The Host Parasite Catalogue is especially useful for it lists all species of birds for which blood parasites have been recorded. For example, the listing for Saw Whet Owl is: ***Aegolius acadicus*** (Gmelin) (southern Mexico throughout Nearctic), ***Leucocytozooan danilewsky***, Fallis & Bennett, 1961. ***Leucocytozoon ziemanni.*** Khan, 1975., ***Leucocytozoon sp.*** Bennett & Ballis, 1960. ***Plasmodium sp.*** Beltran & Pardianas, 1953, ***Trypanosoma avium.*** Bennett, 1961, 1970, ***Trypanosoma sp.*** Bennett & Fallis, 1960; Stabler & Holt, 1965.

Note that the references listed above are not in the catalogue itself. If you wish to check a reference then you will need to purchase the bibliography as well. I hope this information is of use to other rehabilitation centre staff.

Kevin Moore, Manager
Wildlife Division
Salmonier Nature Park
Holyrood, Newfoundland

Dear Editor:

After four years of wildlife rehabilitation work, I've begun to question a lot of my early assumptions. Such as: Every animal has to be saved from the enemies—illness, pain and death; human healers and medical technology are the best treatment the world has to offer an injured animal; the wilderness, with its cold, dirt, infection, starvation and predators, is a poor place in which to heal; all animals welcome the chance to get the benefits of rehabilitation care.

Nowadays I find myself wondering: Is rehabilitation care and treatment always the best option? Is nature a better place to refer some patients? (For example, medication can weaken immune systems, mask signs, and promote microbial growth. Captivity itself can compromise health through stress, contagion, unnatural diet, handling, and unavoidable contact with feces.)

Is hospice care, rather than medical treatment, the best option in some cases? Is a quick death, natural or induced, sometimes preferable to long-term treatments? Is death the enemy? Is it even possible to beat it? Is death one form of healing?

Do I have something to learn from wild creatures about living and dying? Many have an inspiring will to live — it may be their most powerful medicine. Many have an inspiring will to die when that time comes — and no human medicine can "cure" it.

Might I look at every creature's birth, growth, illnesses, injuries, pain, healing and death as parts of the flow of a river we call nature, with humanity's substream flowing along one edge of that river? When an orphaned or injured wild creature drifts into our substream, isn't it most appropriate to help it get back into its own part of the river as soon as possible?

I wonder if I get so involved in our substream that I forget the river. Maybe nature itself is the healer, and I'm just an assistant, invited to assist on a few cases.

Maybe a wild creature who finds itself in a rehab situation is like a traveler stuck in a foreign country. Sounds, sights, food, microbes, language, healing ways, routines, pace, one's means of support and relationship to those nearby, all are changed and foreign. A lot to adapt to at once. My job as a rehabber includes recognizing and minimizing these foreign stresses. And returning the visitor to its own land as soon as possible.

I don't have any answers to these questions. But they've changed my perspective, and changed how I see my role in rehab work.

Jane Stevens
Sunriver Nature Center
Bend, Oregon

Jane:

I think this is an excellent opportunity to stimulate some reader response so I will hold my thoughts on your letter and let IWRC members reflect and respond if they would like to.

Jan White

Book Review

Body Weights of 686 Species of North American Birds

John Dunning, Jr.
Western Bird Banding Association
$3.75, 89 pgs.

Recently I was asked to review this book which I have had since 1984. Dog-eared pages that are "poop-splattered" tell a tale of a needed companion. I used it my bird-raising days and now use it to know "ideal weights" as a basis of norms for the non-releaseable animals at the Lindsay Museum. Handily, it tells you where the weights were taken, which is helpful since the northern dwelling birds tend to be a bit heavier that those from the south. We are also reminded that birds in a variety of physical conditions are banded and weighed, including emaciated ones at the end of migration. It also gives the sample size so that it is clear whether the weights represent the average of a few or many.

It is extremely important to read the introduction of this book. The reader will fare better at interpreting the Table of Weights by reading the "how-to." I also use a conversion scale for grams as I am not always handy to a scale that reads in grams.

The book offers both a scientific and English index. This makes it very readable for a rehabber who just knows a Red-tail Hawk or Blue Jay. Normal body weight is a reference very needed as a part of a basic rehab library. The Western Bird Banders did a comprehensive job of covering the United States and making this a timeless addition to the bird information available. As we all know, weight changes are extremely important for knowing more about the birds we raise for release or the adults that come in injured or debilitated. The cost is very reasonable and the book is currently available. Get them while you can. It can be orderd by writing Mr. Rick Bowers, 2925 N. Cascada Circle, Tucson, AZ 85715.

Diana Granados Facilities Manager,
Alexander Lindsay Museum
IWRC Board Member
Walnut Creek, California

Available in September
1989 Proceedings
"IWRC on the Move"

Papers included in the book include: Animal Bites/Tick Borne Diseases Steve Waring D.V.M., Housing Avian Insectivores During Rehabilitation by Paul & Georgean Kyle, Deer Fawns as Victims of Fire Ants by Ann Connell, Care of Insectivorus Bats by Susan Barnard, Exotics in Wildlife Rehabilitation by P.C. Hanes, Swifts by Paul and Georgine Kyle, Who Cares About Sea Turtles ? by Carol Allen, Why Wildlife Rehabilitation? by Allen Tennant

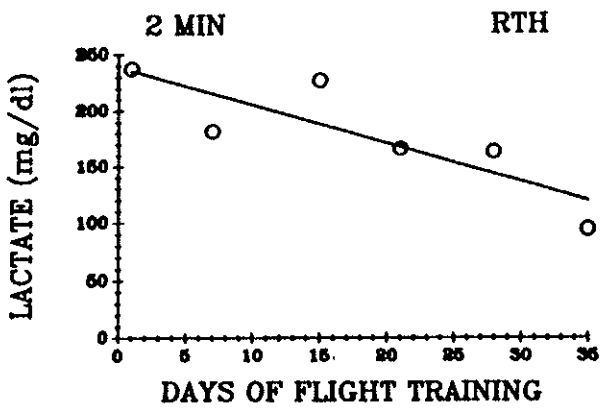


Fig. 2. Blood lactate concentration (mg/dl) at 2 minutes post standardized hallway exercise as a function of days of flight training in one Red-tailed Hawk. A best-fit linear regression of individual data points was obtained with Sigma-Plot software.

A steady decrease in both the 2 and 10 minute lactate levels was observed in all of the Red-tailed Hawks during the course of their flight training (See Figure 2 for 2 minute levels). Linear regressions were fitted to the data using Sigma-Plot software (Jandel Corp.) for each individual, so that they could be compared as a group (Figure 3). The initial 2 minute lactate levels were higher, and the rate of decline was steeper, in hawks that had severe wing injuries (Fig. 3 a, b, c). These individuals required more than 3 weeks of flight training. For example, the hawk whose regression is labelled (a) in Fig. 3 was admitted with extensive soft tissue damage to one wrist; it was confined to a cage for treatment for over 100 days before going to the flight room, and was a weak flyer when initial flight training was begun. It took five weeks of training (the last two weeks of which included both indoor and outdoor flying) to improve the bird's flight fitness adequately.

Table 1. Percent Decrease in Respiratory Rate from 1 Minute to 3 Minutes Post Exercise in Red-tailed Hawks.

	Flight Training Period	
BIRD	EARLY	LATE
RTH 183	44.6	38.7
RTH 165	42.5	39.5
RTH 154	21.9	31.8
RTH 135	36.6	48.1
RTH 625	32.2	33.4
RTH (Martell and Redig, 1986)	(--)	40.5

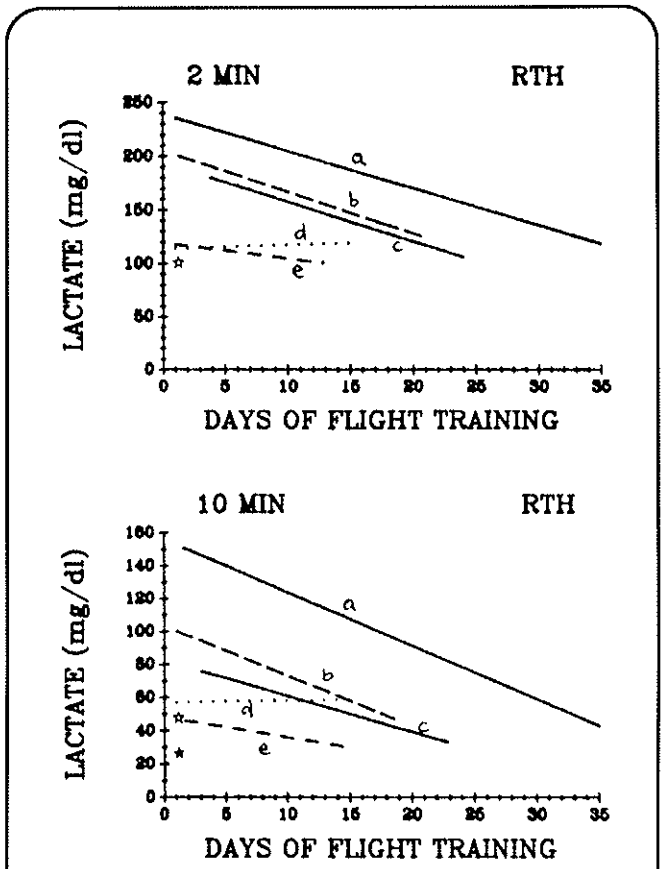


Fig. 3 Blood lactate concentration (mg/dl) 2 and 10 minute post standardized hallway exercise as a function of days of flight training in five Red-tailed Hawks. The open star represents data from a falconry-trained Red-tailed Hawk (a "fit" bird); the closed star represents mean lactate concentration of two Red-tailed Hawks anesthetized with Ketamine-Rompun for 10 minutes.

In contrast, hawks admitted with mild injuries exhibited much quicker recovery during convalescence, much less loss of fitness, and consequently a faster reconditioning period (usually less than 2 weeks). For example, the hawk whose regression is labelled (e) in Figure 3 was admitted with a simple ulna fracture and was confined to a cage for 35 days. This individual's initial 2 minute blood lactate level was close to the endpoint, which meant that very little flight training (10 days) was needed for complete rehabilitation.

After two to six weeks of flight training, all of the hawks achieved two minute lactates of 100-120 mg/dl, which was considered to be the endpoint of their training. In addition, the 10 minute lactate levels in these birds were 30-50 mg/dl, close to that of anesthetized hawks, indicating complete recovery from exercise.

Post exercise respiratory rates of the hawks did not change significantly with flight training. We determined the percent change in respiratory rate from 1 minute to 3 minutes post flight and compared individuals during the early and late phases of their

flight training (Table 1). In three of five birds, the percent change was the same or higher during the late phase, compared to the early phase, although marked changes in the blood lactate levels were apparent at these two periods. In addition, respiratory rates of the hawks were elevated (> 50 breathes per minute even 10 minutes post exercise. One reason for this was the moderate hyperthermia induced by the exercise, and the need to dissipate heat by panting (Fig. 4).

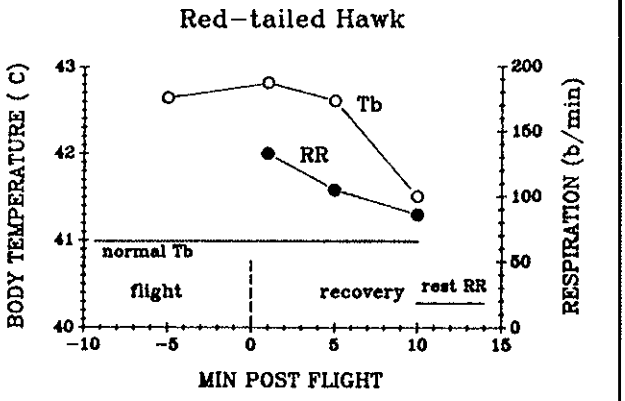


Fig. 4 Body temperature (Tb, open circles) and resipiratory rate (RR, closed circles) of a Red-tailed Hawk during and after a standardized hallway flight exercise. Normal daytime Tb data from Chaplin et al. 1984.

Conclusions

Flight training using the kind of short-distance standardized exercise employed in this study encourages development of aerobic conditioning. Improvement in aerobic capacity is evidenced from the decline of 2 and 10 minute lactate levels, thus dependence on anaerobic metabolism, throughout flight training. We have demonstrated that the flight fitness of Red-tailed Hawks can be determined by measurement of blood lactate levels at 2 and 10 minutes after a standardized exercise. However, there are some cautions to using this technique: 1) Birds should be used to the flight course, because the stress of flying in a different place will affect the lactate levels; 2) Birds should always be flown in the same way (standardized),so that performance can be compared from one time to the next or over the course of the training period; 3) Blood sampling should be performed in as non-stressful a way as possible (e.g., a quiet room, gentle handling, not touching the bird except to obtain blood or to restrain it.)

Regressions of 2 and 10 minute lactate data over the training period can provide some useful information about the progress of a rehabilitated hawk toward a physiologically fit state. The difference between the initial 2 minute lactate level and the desired end-point (100-120 mg/dl) gives an indication of how much training will be needed (i.e., less than three weeks, more than three weeks). The slope of the regression indicates how rapidly the conditioning is proceeding; if the slope is too flat, then the bird may have a problem with wing mechanics or the training itself may be inadequate (too few flights, or too few exercise periods). Finally, and most importantly, the 2 and 10 minute lactate levels determine when good aerobic condition has been achieved and at what point the bird could be released.

We have used this technique for evaluating flight fitness in Red-tailed Hawks, Rough-legged Hawks, Great Horned Owls, and Barred Owls, and the training end points are the same for all of the species, using the standardized exercise of 10 hallway flights, or about 850 feet total distance. There are some limitations to the use of the lactate technique which should be noted. We do not know how well this technique will apply to other species, especially small-bodied raptors like kestrels or screetch owls, and we do not feel that end points of training established in this study should be applied to birds that are exercised in other ways, such as creance flying or pen flying. The end points for those types of exercise will have to be determined.

One criterion of flight fitness that has been used in the past is recovery of respiratory rate post exercise (Martell and Redig, 1986). However, we found that respiratory rate of Red-tailed Hawks post exercise was a poorer indicator of physiological fitness than blood lactate concentration post exercise, because it is complicated by thermoregulatory demands for heat dissipation in large-bodied hawks. Thus, we do not feel that post exercise respiratory rate should be a criterion for release in these birds.

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