RAPTOR MANAGEMENT AND REHABILITATION

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The medical and surgical treatment of injured raptors has potential for significantly mitigating the effects of unnatural mortality among certain species, notably the Bald Eagle and Peregrine Falcon. Since 1972 over 1200 raptors have been treated in our facility, 101 of which were eagles and 15 were Peregrine Falcons. The relevance of rehabilitation as a management tool is discussed in the context of the overall status of raptor management.

The management of raptors has become a subject of considerable widespread interest only since about 1966 (Fyfe, 1976). Since then there has been a great deal of research performed, primarily through academic institutions. Such research has been only partially related to management and has most frequently been very local in geographic scope and narrow in terms of subject scope (e.g., behavior at the nest, nest site habitat, food habits during the breeding season). Fuller (1978) has made the observation that the majority of raptor field studies have been conducted on the plains of the Western United States. With the exception of a few locally studied areas such as the Bald Eagles in the Great Lakes States, and studies done in Florida, Ohio, and Pennsylvania there is a real paucity of literature pertaining to eastern raptors. These patterns possibly relate to those general difficulties of studying the thinly distributed populations of very mobile, wide ranging predators. In the eastern forest,observations (other than at nest sites), are very difficult; thus more studies have been done in open areas. The scarcity of research leaves little for the manager to work with. However, the raptors respond to the same management principles as those already researched and in use for species that have been managed for forty or more years (Hamerstrom, 1974). Thus the obvious conclusion of habitat preservation as a key item in the survival formula of raptors is easily achieved. For the practical purposes of developing management programs a breakdown into specific areas of effort within the framework of habitat preservation is necessary. Of the many approaches that may be taken, there are four facets which have been experimented with to considerable degree in the management of raptors during the 1970's and these are: 1) identification and protection of nesting sites, 2) providing and protecting uncontaminated food supplies, 3) augmenting production through providing additional nesting sites where a shortage of these is identified as a limiting factor, captive rearing and release of youngsters through fostering or hacking, and manipulation of clutches at either the egg or nestling stage, and 4) reducing mortality in the wild by identifying major causes of injury and mitigate their effects by removing the hazard where possible and by providing medical and surgical care for injured individuals so they may be again released.

It is from the latter point that I draw most of my experience having been directly involved with providing medical and surgical care to over 1200 raptors since 1972. It is the purpose of this paper to present the justification and significance of raptor rehabilitation as a management tool within the context of present day

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raptor population conditions and proposed and actual management schemes for these birds.

The reasons for managing raptors go beyond the fact that they are a wildlife resource and an important portion of the ecosystem in need of protection and conservation. Several species of North American raptors, notably the Bald Eagle, Osprey, and Peregrine Falcon have undergone precipitous declines over much of their former ranges in the last 30 years (Hickey 1969, Wetmore and Gillespie 1976). The Peregrine in particular has been completely extirpated from its range in the eastern United States and only a remnant population is left in the western United States (Fyfe et al. 1976). The documentation of the disappearance of the Peregrine at the international conference held in Madison, Wisconsin in 1965 contributed significantly to the awakening of this country to the problems of industrial and agricultural pollution and to the eventual banning of DDT in the early 1970's (Hickey 1969, Peakall 1976). Acting in concert with the pollution problem has been the widescale loss of habitat, a problem which has contributed heavily to the demise of the Bald Eagle over most of the 48 states. There are several other raptorial species such as the Merlin, Cooper's hawk, Red-shouldered Hawk, and the Marsh Hawk which are known to have undergone declines in certain locales and which, because of their particular food preferences or habitat requirements are particularly vulnerable to disturbances of these parameters. However, these 4 species lack the special dash and appeal of the Peregrine and Bald Eagle and therefore have not been given as much attention. The basic censusing data is not even available on these raptors to make a meaningful determination of their status over most of their range.

There is also a significant utilitarian reason for the management of raptors. Since the various species occupy niches at the tops of long and complex food chains and have specific requirements for nesting, they can be useful as environmental barometers. A healthy diversified, regularly reproducing raptor population in a given area implies that management programs directed toward forest and wildlife production are being conducted in accord with principles of maintaining a balanced ecosystem.

Because of the importance of raptors and the ecological information that can be obtained from monitoring and managing their populations, the USFWS in 1978 created a position within their ranks, that of a raptor biologist. Through this office there is the potential for efficiently directing and funding needed research on raptors,for standardizing census and survey techniques which will permit a synthesis of local situations into broader conclusions about populations, and to test and suggest management strategies. Through contractual and cooperative agreements there are many new opportunities for raptor research and management ahead.

Cade and others have pointed out previously that we know the necessary principles to implement management programs for raptors (Cade 1974). These principles include inventory of the breeding stock, reproductive rates, survival of various age classes, and determination of limiting factors, followed by scientific manipulation of these factors. However, because of the solitary nature of raptors, their position at the top of complex food chains, their relatively few numbers, and their great mobility the task of determining basic management parameters involves considerably more effort and expense than that required for many of the game species to which these techniques have been so successfully applied.

The censusing of nest sites and implementation of management programs for nest sites, the first of the four management approaches presented above has been very successfully accomplished in the case of the Bald Eagle population in the Great Lakes States. Broad scale censusing coverage of the eagles in these states (Minnesota, Wisconsin, Michigan, Ohio, Indiana, and Illinois) has been conducted since 1973 (Madsen 1977). Over 400 pairs of birds are observed regularly and it is estimated that over 90% of all active nest sites are included in the survey. Fixed-wing aircraft have been extensively used for making observations. The results of these surveys from 1973 through 1977 are included in Table 1. Based on the number of young produced and the relative constancy in the number of nest sites occupied, the eagle population in this area is certainly stable and shows a trend indicative of an increase.

Table 1.--Bald eagle breeding population and breeding success, Great Lakes States, 1973 through 1977. From Madsen, 1977.

State	1977		1976		1975		1974		1973	
	Occupied Nests	# Young	Occupied Nests	# Young	Occupied Nests	# Young	Occupied Nests	# Young	Occupied Nests	# Young
Wisconsin	151	181	146	139	111	112	109	103	108	107
Michigan	87	95	84	80	88	79	82	45	83	66
Minnesota	156	179	122	163	120	145	127	96	115	113
Ohio	4	1	5	2	5	3	6	2	7	2
Illinois	0	0	0	0	0	0	2	0	0	0
Indiana	0	0	0	0	0	0	0	0	0	0
Total	398	456	357	384	324	339	326	346	313	288

The Bald Eagles on the Chippewa Forest, a relatively small (6400 km^2) and intensely managed forest, have been studied since 1963 (Mathisen et al. 1977). A two-flight survey conducted in fixed-wing aircraft has been shown to provide an adequate means for detecting substantial changes in the population status of this much studied and closely monitored population (Fraser 1978). Because of the numerous studies conducted on this population of eagles, management is moving from a general approach of protecting habitat and eliminating disturbance to a specific approach involving the formulation of management plans for specific eagle territories. These specific plans take into account the tolerance of a given pair of eagles to certain types of disturbance as determined by quantitative experimentation (Stalmaster 1978), unique features of a given territory such as proximity to water, to construction work or projects involving frequent intrusion to the area for inspection or repair, and finally the potential for future alteration of the habitat by logging, dam construction, and recreational development (Mathisen et al. 1977).

By contrast other investigators studying Bald Eagles over much large tracts of land such as the 100,000 km^2 area surveyed by King (1972) or the 174,000 km^2 are surveyed by Grier (1977) chose to randomly sample their areas and make inferences about the population status and trends on that basis. Because of the differences that exist among various eagle populations with respect to habitat type and usage, and levels of human activity within eagle territories, the point has been made that for successful comparison of the results of various studies, what is needed is not complete standardization of field procedures or analytical techniques, but rather standardization of the parameters being measured (Fraser 1978).

The integration of forestry management policies with the requirements for successful and stabilized eagle production on the Chippewa National Forest are now well established. The Minnesota Department of Natural Resources with cooperation from the U.S. Fish and Wildlife Service is about to implement a management plan for eagles not nesting on public lands under federal jurisdiction. There are 44 known nesting sites of Bald Eagles outside of national forests in Minnesota (Henderson, personal communication, 1978). Land ownership status of these nest will be determined and management implemented on a recommendation basis utilizing practices that have proven to be efficacious on the Chippewa.

Specific nest site identification and protection is a useful approach for species such as the eagle where the nest is located in unique places and is frequently reused. The cliff nesting raptors such as the Peregrine Falcon and the Prairie Falcon also have readily recognized and frequently reused nest sites which would render them amenable to management programs similar to those developed for nest site protection of the eagle. For most other species of raptors, nest sites are decidedly more ephemeral and the unique common feature of sites are not as readily recognized. However, recent research on Broad-winged Hawk nest site selection (Kerans 1978) and Marsh Hawk nest site selection (Hamerstrom 1976) has shown that indeed there are some unique features sought by these birds which can be defined by continued research. Kerans (1978) concluded that in the case of the Broad-winged Hawk, the current 40 year cycle on which white-tailed deer and ruffed grouse management was based would indefinitely provide adequate nesting habitat for this species.

Of course considerations must go beyond simply the nest site and take into account the need of the parent birds for hunting, roosting, and freedom of conflict with other species of raptors. A radiotelemetry study recently completed at the Cedar Creek Natural History Area in East Central Minnesota (Fuller 1979) provides data on the spatial and temporal partitioning of woodland habitat by resident raptors, providing forest managers with yet another set of parameters to place in their management equation.

Another approach toward eagle management in the Upper Mississippi region is that of protecting wintering roost sites. A private organization, the Eagle Valley Environmentalists, has been the main promoter and executor of this concept since 1972. Their approach has been to identify sites where large numbers of eagles roost at night and raise money to buy the land on which these sites are located, or enter into easement agreements with landowners to insure preservation of the roost site on a long term basis. Without downplaying the importance of wintering habitat for eagles, other investigators have advised caution in the large scale outlay of public and private money to buy eagle roost sites outright since the occupancy of these sites is affected by local annual variations in weather and food availability (Grier 1977).

The second approach to raptor management for which there are some programs currently implemented is that of insuring uncontaminated food supplies. Whereas toxicity to raptors due to the food chain transfer of agricultural pesticides and industrial pollutants has been well established as in the case of the Peregrine Falcon, the hazard of secondary toxicity from lead pellets ingested with the flesh of prey species has only recently been recognized (Locke 1969, Mulhern et al. 1970). Locke (personal communication 1978) has autopsied 15 Bald Eagles in which secondary lead poisoning was suspected and later confirmed in nine of them. This author has seen secondary lead poisoning in 3 Prairie Falcons, 1 Goshawk, and 1 Bald Eagle. Among raptors the Bald Eagle is particularly vulnerable to secondary lead poisoning since they frequently scavenge on crippled ducks and geese during and after the waterfowl season. It is believed that toxicity occurs because of a failure of the pellet casting mechanism to cause expulsion of the pellets. Studies are currently underway at the University of Wisconsin (Temple and Friend) and at the University of Minnesota (Hennes, Frenzel, Duke, Redig, and Henderson) to assess the magnitude of secondary lead poisoning in eagles. It is likely that management decisions affecting the use of lead shot in certain waterfowl hunting areas will be forth coming based on this research.

The continued pesticide contamination of arctic Peregrine Falcons is an example of a food contamination problem for which the implementation of remedial management is not immediately possible. These birds are highly migratory and many pass along the Gulf Coast of Texas each year enroute to wintering areas in Central and South America (Rogers & Hunt 1975). It appears that the very heavy utilization of DDT in these countries is the source of contamination for these birds and their migratory food supplies (Burnham 1978). It has been suggested by resolution at the Raptor Research Foundation in 1976 that chemical pesticides deemed unsuitable for use in the United States not be allowed export abroad by American manufacturers.

Another management scheme that has been proposed for these arctic Peregrines to protect them from heavily contaminated prey is shortstopping (Cade 1974). Migrant Peregrines on southward passage would be trapped, held over the winter

by qualified individuals, and released in following springs at 1,2, or 3 years of age to migrate back to the tundra free of pesticide loads. To date this idea has not been implemented.

The third approach to raptor management, that of augmenting production, has taken several forms. The various methods have included transferring healthy eggs or young birds from successful nests to active sites with a history of repeated failure (Madsen 1977,Burnham 1978), encouraging multiple clutching to occur by removal and artificial incubation of the first set of eggs (Cade 1974, Burnham 1978), captive production of birds and subsequent release into the wild by fostering them into remaining active wild nests or by controlled reintroduction where no wild birds exist (Fyfe 1976, Sherrod and Cade 1978). Increasing the number of available nest sites has been done for Ospreys (Ames & Mersereau 1964, Postupalsky 1974) for Prairie Falcons (Olendorff & Stoddard 1974), for Red-tailed hawks and Great-horned Owls (Grewe 1976), and for Kestrels (Hammerstrom 1974). The specifics of two cases of augmentation are illustrative.

Several Bald Eagle nests along the east coast of Maine had a history of reproductive failure spanning 10-12 years due to heavy pollutant contamination of the adults. A scheme requiring the transfer of healthy partially incubated eggs from Minnesota and Wisconsin nests was proposed. The first Bald Eagle egg transplant was conducted in 1974. Three eggs, comprising two complete clutches, were taken from two nests in Minnesota after 21 to 26 days of incubation. One egg was accidentally destroyed during placement in an active nest. The remaining two eggs were placed in separate unproductive nests in Maine. One addled egg found in each of the two Maine nests was removed at the time of the transplant. Both Minnesota eggs hatched under the foster parents. One eaglet disappeared after 10 days and one successfully fledged. Single dummy eggs were placed in the two Minnesota nests at the time their eggs were taken to hold the birds on their territories. One pair incubated the dummy eggs 10 days before deserting, while the other pair immediately abandoned the nest site. These nests were not reoccupied in 1974, nor were the same nest sites used in 1975 and 1976. It is not known if the donor pairs used alternate sites. In Maine, neither of the 1974 recipient nests was reused in 1975; one was reused in 1976. An alternate nest was used by one pair in 1975 but the other pair is not believed to have utilized an alternate nest. In sum, in 1974 three eggs were removed from two nests in Minnesota and one eaglet was successfully fledged in Maine.

In 1975, the second Bald Eagle egg transplant was conducted. Four eggs were taken from two nests in Wisconsin. One egg was placed into each of four nests in Maine. One egg was not accepted by the foster parents. Of the three eggs incubated, two hatched and one eaglet fledged. Five of six eggs and shell fragments of a seventh egg found in the four Maine nests were removed at the time of transplant. There were 39 active nests located in Maine in 1976 and six to ten were candidates for transplanted eggs. Although still active, the candidate nests had at least a five year history of failure. These nests were located along the Atlantic Coast, Penobscot River drainage, and Moosehead Lake. Eight Bald Eagle eggs were transplanted from two nests in Wisconsin and two nests in Minnesota. Of the eight eggs taken from the lake states, two eaglets fledged (Madsen 1976).

The Peregrine Falcon has been the subject of a large scale breeding and release program conducted in the United States by the Peregrine Fund at Cornell University (Sherrod and Cade 1978) and by the Canadian Wildlife Service in Alberta, Canada (Fyfe 1976). At Cornell from 1970 through 1977, 229 falcons have been produced of which 133 were released by various methods between 1974 and 1977. In 1976 and 1977 a few of these released birds were observed returning to their release sites and there is one known instance where a captively reared female has paired with a wild male and produced offspring (Cade 1977). Grier (1976) estimated that, based on regular rates of production and mortality for healthy peregrine populations, the release of 250 falcons per year for 15 years would be required to re-establish the Peregrine east of the Mississippi River to approximation of its former level. The results of the captive rearing program have so far been very encouraging, but it will be a few more years before any reliable forecasts of the eventual outcome can be made.

The last of the four management approaches to be discussed is that of reducing mortality. The primary thrust in this regard has been the grass roots development of a large number of so-called raptor rehabilitation programs across the country over the last eight to ten years. A survey was conducted during the summer of 1978 to document the magnitude of raptor rehabilitation in the United States (Duke, Clarke, and Redig). 500 questionnaires were mailed out to individuals who had now or at one time held a federal permit for tending to injured raptors or had otherwise expressed an active interest in the subject; 202 replies were received. A 3 years total of 5,329 raptors of 39 species was reported. Since there are a sizeable number of raptors being submitted to these programs, examination of the reasons for admission of injured birds could reveal some of the signficant causes of injury and mortality among raptors. This type of information as well as success rates were sought by the original questionnaire; however, due to many inconsistances in record keeping among respondents, the information is not presently too significant. A standardized record keeping and summary form is now being drafted for use by all persons holding rehabilitation permits and will be distributed through the Raptor Information Center.

The records from our own program do provide an insight into the numbers and types of injuries incurred by raptors in this region and the type of success that can be realized from a rehabilitation effort. Table 2 is a list and a tally of the raptors we have handled at the University of Minnesota from April 1, 1972 through December 31, 1978. Table 3 is a summary of the problem categories for which these birds listed in Table 2 were submitted. Table 4 is a specific breakdown of problem categories for Eagles and Peregrine Falcons for 1977.

Approximately 75% of the raptors handled were presented for traumatic injuries; in most instances there were fractures of one or more of the long bones. In recent years techniques have been described for the anesthesia of raptors (Redig and Duke 1976, Paddleford 1978) and for the reduction and fixation of fractures of the long bones of raptors (Redig and Rausch 1978). The degree of success achieved in the repair of fractures and other injuries has depended upon which bone was broken, the duration of time since the injury, the severity, and the cause. Prognostic evaluations can be made only by a clinician with experience in handling avian fractures. Rehabilitation goes far beyond caring for the obvious fracture or injury, requiring expenditure of time, effort, and expertise in providing adequate housing, nutrition, and vigilance against the development of other diseases and problems to which raptors are susceptible.

The category that has proven to be the most difficult to handle is trap-induced injuries. In any given year these injuries comprise about 16-20% of our admissions and have the lowest chance for successful repair. Table 5 is a cumulative listing through 1977 of all raptors admitted with trap injuries. Table 6 is a specific listing of trapped eagles. Only 3 out of 15 trapped eagles were released and these were all partial amputees. Most of the trapping incidents involved eagles caught in open-baited traps set for furbearing animals during the winter. Trapped limbs freeze quickly and there is no chance for rejuvenation of frozen tissue. However, we have several instances on record where the limb did not freeze but the impact of the trap caused sufficient soft tissue damage to lead to vascular destruction and subsequent loss of the limb below the injury site some 10-14 days after the injury. Because of these types of findings, I take exception to the investigators who recently reported raptors caught in traps in the conduct of turkey predation study could be released if damage was confined only to bleeding at the trap injury site or only one broken leg (Beasom 1974).
Another sequelae observed in birds with trap or frostbite injuries is the development of vegetative and septic endocarditis, that is bacterial colonization of the heart valves following the introduction of organisms at the wound site with embolic transfer via the blood stream to the heart and occasionally the brain, (Wallach and Fleig 1969, Angrist et al. 1960, Redig 1978). The subsequent potential for cardiac malfunction is sure to shorten the life span of the animal. It would seem that this trapping problem could be managed by restricting the use of open bait sets and by educating the trapping public to the hazards their activities may have for non-target wildlife.

Table 2.--Species and numbers of raptors admitted for treatment at the University of Minnesota from April, 1972 through December 31, 1978.

Red-tailed Hawk	238	Goshawk	40	Screech Owl	58
Red-shouldered Hawk	15	Merlin	2	Burrowing Owl	1
Broadwinged Hawk	101	Kestrel	149	Saw Whet Owl	18
Swainson's Hawk	6	Prairie Falcon	29	Boreal Owl	1
Ferruginous Hawk	6	Peregrine Falcon	15	Barred Owl	58
Rough-legged Hawk	52	Gyrfalcon	5	Great-Gray Owl	3
Harris' Hawk	1	Bald Eagle	101	Long-eared Owl	27
Marsh Hawk	13	Golden Eagle	20	Short-eared Owl	20
Sharp-Shinned Hawk	20	Osprey	16	Snowy Owl	24
Cooper's Hawk	16	Turkey Vulture	5	Great Horned Owl	215
				TOTAL	1,275

Table 3. Summary of causes of injuries to raptors submitted to the University of Minnesota.

Injury	1972-1974	1975	1976	1977	1978	Overall
Projectile	34	35	23	16	13	24
Traps	25	12	8	7	4	11
Accident	22	30	37	46	49	37
Disease	8	5	12	8	2	7
Orphaned	3	10	15	12	14	11
Other	8	8	5	10	18	10

Table 4. Breakdown of problem types for which Eagles & Peregrine Falcons were submitted in 1977.

	Eagles		
	Bald	Golden	Peregrines
Projectile	6	5	1
Trap	3	1	
Accident	7	1	2
Starvation	2		
Orphan	5		
Other	3		

Table 5. Listing of all raptors submitted for treatment of trap-induced injuries, other than pole traps.

Species	Year/Number				
	1974*	1975	1976	1977	Total
Great Horned Owl	5	5	9	5	24
Snowy	1			1	2
Barred Owl		2			2
Screech Owl	1				1
Red-tail		9		3	12
Rough-legs	1	1	1	3	6
Marsh Hawk			1		1
Broadwing				1	1
Kestrels		1			1
Bald Eagles	2	1	1	6	10
Golden Eagles	1		1		
Totals	11	19	13	19	62

*Records prior to 1974 are inaccurate except for eagles.

Table 6. Listing of Bald and Golden Eagles submitted for treatment of trap-induced injuries. From Redig (1978).

	Clinic #	Locale of Origin	Fate
1973	1	Paynesville, MN	Released after amputation of DII
	2	Hastings, MN	Released after amputation of DIII
	3	Brainerd, MN	Died
1974	A-4	Benson, MN	DOA
	A-75	Detroit Lakes, MN	Died after surgery to repair fracture
(Golden)	A-105	Fergus Falls, MN	Died
1975	B-129	Michigan	Held as a 1-footed cripple
1976	C-193	Fergus Falls, MN	Died after foot was lost
(Golden)	C-203	Illinois	Died
1977	D-29	Rhinelander, WI	Foot amputated-bird died later
	D-206	Michigan	Foot amputated locally-DOA
	D-271	S. Dakota	Both feet destroyed-bird died
	D-274	Fergus Falls, MN	Released with slight damage to DIII
	D-298	Ely, MN	Halux destroyed-bird crippled
	D-306	Alexandria, MN	Both feet destroyed-bird died

Total # of trapped eagles died - 10
Total # of trapped eagles crippled - 2
Total # of trapped eagles released - 3

Another subtle problem whose actual statistics are buried in the "accident" category is that of raptor collisions with power lines. Nelson (1978) and Crawford et al, (1974) have documented the electrocution of raptors by power lines and suggested management remedies. The injuries referred to here are not electrocutions, but simple collisions resulting in fracture of the wings usually. Fitzner (1975) briefly described this hazard for owls. In 1978 alone our program has received 2 Bald Ealges, 2 Ospreys, 1 Golden Eagle, 1 Broad-winged Hawk and 1 Peregrine Falcon which were injured by flying into wires. In all cases the injured birds were found adjacent to high tension power lines and no other cause of injury was found upon examination. One Osprey was admitted with a fractured coracoid; all others received fractures to the wing bones proper. The significance of this type of injury in light of the many other means by which much larger numbers of birds are destroyed may be questioned, nevertheless, the birds do hit wires and there are more and more high tension lines being strung completely across Minnesota and elsewhere. It is conceivable that these lines could have some significant effects on local populations of raptors.

One of the measures of success of such a program is the disposition of the birds treated. Table 7 is a summary of our attempts through 1977 and Table 8 is a specific summary of the disposition of Eagles and Peregrine Falcons (Redig 1978). Of even more significance is the survivability of rehabilitated raptors after they are released. Approximately 500 raptors have been released from this program with all birds bearing conventional USFWS bands. So far returns have been reported on 5 of these birds with survival rates ranging from 2 weeks to 4 months. More useful information has been obtained from a color marking scheme employed for Bald and Golden Eagles in addition to banding. Of 28 eagles marked with vinyl wing markers, subsequent sitings have been made on 8 birds. Two of these birds were released on the Swan Lake Refuge in Missouri in 1976 (Griffin and Redig) and their progress followed through February when the mass of wintering eagles departed the refuge. Another young eagle released at the Montezuma Wildlife Refuge in Upstate New York in early September was followed for 6 weeks before it became entangled in barbed wire and died. Postmortem examination of this bird revealed that it was in a good nutritional state. Another adult eagle marked and released on 3/19/76 was reported during the spring of 1978 to be occupying a nest with young eagles near Harris, Minnesota. And another adult released on 12/28/73 was found in June, 1974 by Chuck Sindelar at a Wisconsin nest with 2 young in the nest. One last example is an eagle originally shot near Oshkosh, Wisconsin on 6/8/76, banded and released on 9/4/76 at Duluth, and seen

Table 7. Summary of rehabilitation attempts for all species of raptors (Percentages in each year). From Redig (1978).

	1975	1976	1977	Overall
Died	30	22	15	22
Destroyed	3	8	11	7
Holding	8	13	9	10
Research	16	15	10	14
Successfully Rehabilitated	43	43	39	42
Pending*	0	0	16	5

* Indicates raptors not ready for release at end of the year, but for whom complete recovery is anticipated.

Table 8. Disposition of eagles and peregrines (Percentages in each year). From Redig (1978).

	1972-1974	1975	1976	1977	Overall
Died	47	27	41	18	33
Holding	0	7	0	11	3
Research	26	13	18	19	19
Successfully Rehabilitated	27	53	31	26	37
Pending	0	0	0	26	8

again on 9/5/76 3 miles north of the release site and again in mid-January on the Swan Lake Refuge in Missouri.

During the spring of 1978, 5 nestling Bald Eagles were brought in at various times after they had been blown from their nests during storms. 3 of these birds were admitted with leg fractures. Approximate age of the birds at the time of admission ranged from 3 weeks to 12 weeks. The two uninjured birds were given physical examinations, held for a week of observation, and then fostered back to other 1 chick eagle nests. One of these birds was approximately 4 weeks old and the other 12-13 (nearly fledged) at the time fostering was done. No serious aggression with other eagle chicks or problems with adult acceptance were observed during subsequent observations. Of the other 3 chicks, one had fractures in both legs and convalescence was not complete until mid-September. He was not released, but rather placed in a captive breeding project. Both of the other birds underwent surgical repair of their tibio-tarsal fractures and completed convalescence before the end of the eagle nesting season. One bird was put back in a nest near Drummond, Wisconsin on July 1, 1978. There was a single chick in the nest about 2 weeks younger than the rehabilitated bird. There was momentary aggression between the two chicks manifested by threat postures, but no contact. Ground checks made on July 3,4, & 5th revealed only one bird in the nest; on July 6th, 2 chicks were seen sitting on the edge of the nest.

The remaining rehabilitated bird was taken to a nest near Minong, Wisconsin on July 15, 1978. Again there was 1 chick, nearly ready to fledge in the nest. The new bird was placed in a dead snag 30 m from the nest tree and about 5 m off the ground. No observations were made until July 20th at which time 1 chick of uncertain identity was seen in the nest and 1 adult in the nest tree. On July 28th the color marked youngster was observed in a tree about 200 yards from the nest tree. The unmarked youngster was not seen at that time.

Color marking of rehabilitated eagles clearly yields much more information concerning the post-release survival of these birds. The limited data available so far indicates that in fact these birds will survive and even resume apparently normal patterns of migration and reproduction. Because the post release survivability of rehabilitated birds is important information to have, the time is right for a program of radio tracking of these birds following release to learn more about their reintroduction into the wild.

Clearly, rehabilitation of raptors provides two avenues of direct benefit to the resource, 1) the accumulation of data regarding the causes of raptor injury and mortality on both a regional and national level, and 2) the return of a significant number of individual birds, particularly eagles, to the wild.

By expanding the scale of these operations there is the potential for the recovery of many more raptors. The magnitude of the beneficial effects can be enhanced by promoting centralization of efforts so that there is increased continuity in the learning from old mistakes and application of new techniques and by increasing the level of funds available for this work.

There are also signficant indirect effects that are realized from the project underway at the University of Minnesota. By conducting this work at a veterinary college within a major university, the opportunity is presented to teach concepts and techniques of avian research and medicine to veterinarians and wildlife students who in turn can relate this information to many other people throughout their careers. Crippled birds, unsuited for release are available for use by students and researchers to conduct controlled laboratory testing of hypotheses that can lend significant insight into field observations. Utilization of injured raptors for research in behavior, medicine, surgery, pathology, toxicology and other fields, is possibly the single most important aspect of any rehabilitation project. Such research is a source of new information that will be used in the years to come to provide improved methods for the management of raptors in the laboratory and in the field (Redig 1978).

Lastly, there is a significant benefit to be realized by utilizing material depicting the plight of injured raptors to sensitize the members of the public to the need for raptor and wildlife conservation. Photographs, X-rays, and crippled live specimens can create lasting impressions on the minds of people who wouldn't otherwise be concerned about injured raptors. By increasing the levels of awareness and appreciation for raptors and wildlife among the public, it is hoped that not only the direct mortality-causing effects of human activity, such as shooting and trapping, may be reduced, but also the indirect effects of habitat destruction may be realized and mitigated.

If the whole matter of raptor management appears thin and shallow at this point the reason is likely to be related to the recency of its application. Prior to the mid 1960's, most raptor management was directed toward their destruction; research primarily documented declines in populations for select species. The first significant attempts at management were seen directed toward the Bald Eagle in the mid-to-late 60's, followed by augmentation efforts to save the Peregrine in the early 70's, which efforts have yet to prove their management potential. Reducing mortality by removing hazards and repairing injured raptors is similarly only recently being developed and has yet to be proven a significant tool in the overall scheme. Certainly this multifaceted approach provides a much brighter future for the raptors than was thought possible 10 years ago, but the work is just barely started.

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