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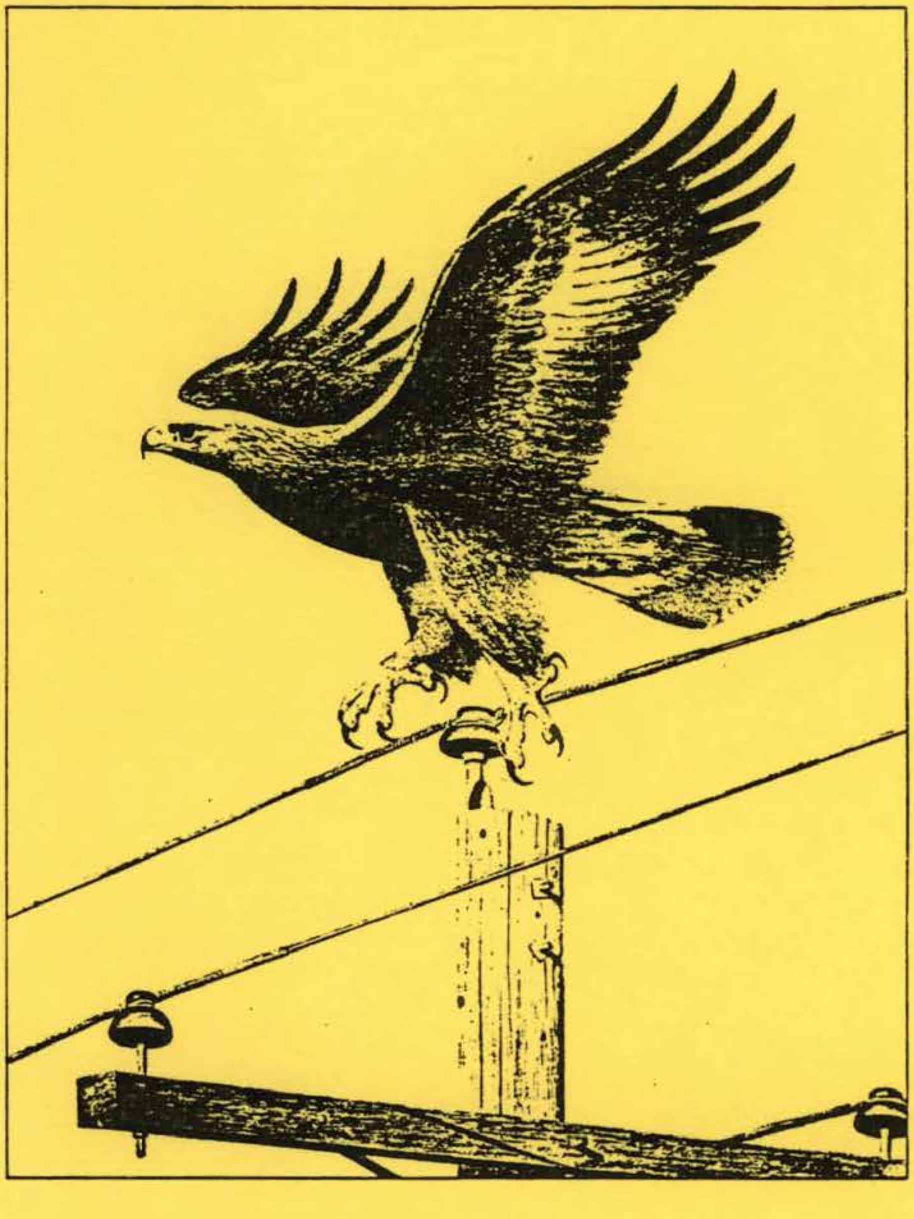
EXCERPT FROM

SUGGESTED PRACTICES FOR RAPTOR PROTECTION ON POWER LINES

THE STATE OF THE ART IN 1981



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Suggested Practices for Raptor Protection on Power Lines

The State of the Art in 1981

by

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William Tilton of North Pole, Alaska, did the cover drawing of a Golden Eagle leaving a power pole.

LIST OF FIGURES

HOW TO USE THIS PUBLICATION

"Suggested Practices for Raptor Protection on Power Lines...The State of the Art in 1981" is organized to provide rapid access for a variety of readers to a thorough but lengthy synthesis of all available information on the subject. The six parts have different values depending on a reader's objective and prior knowledge.

"PART ONE: THE IDENTIFICATION AND RESOLUTION OF AN ISSUE" is a lesson for everyone in successful coordination between conservationists; industry biologists, engineers, and executives; and government staff biologists, land managers, and species managers.

"PART TWO: THE BIOLOGICAL ASPECTS OF RAPTOR ELECTROCUTION" presents the land manager or power line design engineer with a thorough discussion of the biological reasons for raptor susceptibility to electrocution. A better understanding of the biological and ecological relationships involved has been an important stimulus to the development of mutual respect and communication between those interested in solving the electrocution problem.

"PART THREE: POWER LINE DESIGN AND MODIFICATION FOR RAPTOR SAFETY" switches the emphasis toward teaching biologists and conservationists about the electric industry, particularly about the design constraints which do not allow implementation of every conceivable modification or new configuration of power lines that would be safe for eagles. The suggested practices presented in PART THREE have been field tested, for the most part, and are widely applicable, where needed. However, because of the vast diversity of line designs and voltages used by different power companies, across-the-board standards are impractical. Everyone is cautioned not to pull pages from this report and insist that designs be precisely as shown or that suggested practices be implemented unnecessarily.

"PART FOUR: OTHER SELECTED MITIGATION METHODS" concerns techniques for mitigating power line construction, maintenance, and operation impacts -- other than electrocution -- on raptors. Land-use planners and those who develop environmental assessments will benefit from reading PART FOUR even if they need not be concerned with PARTS ONE through THREE.

Those who seek even more information may facilitate their acquisition of the original literature on the subject by using "PART FIVE: LITERATURE CITED AND ANNOTATED BIBLIOGRAPHY." For quick reference to specific points use "PART SIX: INDEX."

Land managers and industry executives who wish only a general overview of the contents of this publication, or any part of it, may read the EXECUTIVE SUMMARY beginning on the following page.

EXECUTIVE SUMMARY

PART ONE: THE IDENTIFICATION AND RESOLUTION OF AN ISSUE. Birds of prey (raptors) are one of the most politically sensitive groups of birds with which industry, governmental agencies, and conservation organizations must be concerned. As end-of-the-food-chain organisms, raptors are both biologically important and environmentally sensitive. Such sensitivities have created considerable academic interest in these birds and their problems (such as electrocution by power lines) and have generated great public demand for better protection and management of raptor populations and habitats.

A new dawn for the raptor conservation movement and for the concept of raptor management occurred during the winter of 1970-1971 in Wyoming and Colorado. During that winter and the subsequent spring, nearly 1,200 eagle deaths resulting from poisoning (30+), shooting from aircraft (800+), and electrocution or shooting along power lines (300+) were documented in agency reports and court testimonies. Continuing discoveries of dead raptors, primarily immature and subadult Golden Eagles, led to certain healthy alliances between industry, government, and conservation organizations dedicated to solving the raptor electrocution problem.

In 1972 the U.S. Rural Electrification Administration published the first definitive guidance on how to minimize raptor electrocution problems on power lines. Between 1972 and 1975, knowledge concerning this subject increased, and a second-generation handbook was produced entitled "Suggested Practices for Raptor Protection on Powerlines." This publication is still widely used by industry and government, but will be replaced by the present report.

Since 1975 several carefully designed research projects involving both the biological and power line design aspects of the raptor electrocution issue have been completed. At the same time, the pertinent literature grew to over 225 references. The following new assessment of this issue and its solutions 1) reflects what was learned between 1975 and 1981 and 2) synthesizes relevant information from all available sources.

PART TWO: THE BIOLOGICAL ASPECTS OF RAPTOR ELECTROCUTION. Raptors are electrocuted by power lines because of two seemingly unrelated yet interactive factors: 1) the distribution, size, behavior, and other biological aspects of raptors, and 2) designs of electric industry hardware which place electrical wires close enough together that raptors can simultaneously touch two or more of them with their wings or other parts of their bodies. The corrective measures that have been developed as a result of recent studies can make both old and new power line configurations safe for eagles. However, to minimize the biological impacts of various land uses as well as the constraints placed on power line design engineers, it is necessary that both industrial and governmental planners, managers, and developers understand the ecological relationships involved.

Large size is by far the most crucial factor which predisposes certain raptors to electrocution. Between 70 and 90 percent of all raptor mortalities along electric distribution lines are eagles. Of all such eagle mortalities, less than 10 percent are Bald Eagles; the others are Golden Eagles.

There are an estimated 63,000 Golden Eagles in the United States south of Canada during the winter months when most electrocution and shooting problems occur (Table 1). Clearly, the Golden Eagle is neither rare, threatened, nor endangered. However, the impact of power lines is not the only factor impinging on Golden Eagle populations. Thus, public demand, industry image, power line reliability, and Federal law all require consideration of Golden Eagles regardless of their current abundance.

The major concentrations of both nesting and wintering Golden Eagles are in the intermountain West, particularly in western shrub and grassland habitats, in combinations of these habitats, and in ecotones between shrub, grassland, and forest habitats. In particular, greater numbers of Golden Eagles are electrocuted where rabbits occur than where only rodents and birds are found.

Raptors are basically opportunistic and thus utilize power lines and support structures for a number of purposes, especially perching and nesting. The heaviest use is as hunting perches. "Still" hunting from a perch is an energetically conservative way to find prey provided good prey habitat is within an eagle's view from the perch. Some power poles are "preferred" by the eagles because they provide considerable elevation above the surrounding terrain, thereby providing the birds a wide range of vision, easy takeoff, and greater attack speed when hunting. Seeking out these "preferred" poles by land managers and industry personnel facilitates the resolution of some local electrocution problems, but in homogeneous habitats one pole would not offer any advantage over another to a hunting eagle; therefore, corrective measures must be applied more widely.

Studies have shown that most Golden Eagle mortalities along power lines (up to 98 percent of identifiable carcasses) are immature or subadult birds, even though the general population is only about 30 to 35 percent younger birds. This disproportionate susceptibility of immatures and subadults to electrocution involves several factors, but none is more important than flying and hunting experience. The fact that immature eagles are generally less adept at maneuvering than adults, especially when landing and taking off from electric distribution lines, has been demonstrated by considerable research. Hundreds of hours of actual observations and analysis of slow-motion 16-mm movies of Morlan W. Nelson's trained immature eagles landing on dummy power poles clearly demonstrated the problems and led to methods for modifying old power line designs and planning new construcion to maximize eagle safety.

<u>PART THREE: POWER LINE DESIGN AND MODIFICATION FOR RAPTOR SAFETY.</u> The basic problems of all power lines which electrocute eagles are: 1) the distance between wires is less than the wingspread of the bird landing or perching on them; and 2) design practices dictate the grounding of particular parts of the equipment to prevent damage from lightning (ground wire placement also decreases effective separation of wires).

Most lines that electrocute raptors are distribution lines (Figure 2) that carry between 12,000 and 69,000 volts. Higher voltage transmission lines (Figure 1) pose little electrocution hazard because wire separation is adequate.

The two main considerations for making electric power poles safe for eagles are: 1) modifications of existing problem lines (Figures 3 and 4) and 2) proper design of new facilities. Both approaches are still vitally necessary, but because of the vast diversity of line designs and voltages used by different power companies, across-the-board standards and guidelines are impractical. Nonetheless, specific problems can be attacked on a broad front including: 1) design and modification of poles, crossarms, and wire placements to effect adequate separation of energized hardware; 2) insulation of wires and other hardware where sufficient separation cannot be attained; and 3) management of eagle perching.

Adequate separation of energized wires, ground wires, and other metal hardware is the most important factor in preventing raptor electrocutions. The objective is a 60-inch (152-cm) minimum separation of conductors. This can be accomplished in retrofitting old three-phase lines by lowering the existing crossarm (Figure 8) or by raising the center wire on a pole-top extension (Figure 7).

Another useful technique is to put 4-inch (10.2-cm) gaps (Figure 9) in ground wires near energized conductors. Lightning will discharge across these gaps, but day-to-day safety is provided to the birds because a gapped ground wire is not actually connected to ground. Leaving the top 20 to 30 inches (50.8 to 76.2 cm) of poles free of wires so that eagles can perch safely is also effective. In addition, the use of grounded steel crossarm braces should be avoided (Figure 11). As a general rule, the less grounded metal that is placed near energized wires, the less the hazard of raptor electrocution.

Armless configurations (Figure 13) and underground placement of wires present special problems involving reliability and/or cost that in some circumstances decrease their attractiveness to the industry. However, new analyses of armless configurations have increased their usefulness in heavy eagle use areas.

Where adequate separation of conductors and potential conductors cannot be attained, insulation of wires and other metal equipment may be the only solution short of redesigning and extensively modifying the line. On three-phase problem configurations center conductor insulation should extend a minimum of 3 feet (0.9 m) on either side of the pole-top insulator (Figure 14).

Two simple and economical methods of making existing problem lines safe for eagles involve encouraging eagles and other birds to perch on less dangerous parts of power line support structures. One method is to install wooden perches 14 to 16 inches (46 to 51 cm) above any energized wire or object so that raptors can sit out of danger (Figure 15). The second technique is to encourage eagles to perch in non-lethal positions on power line structures by placing perch guards (Figure 16) in dangerous areas. Inverted "V" perch guards made of wood, fiberglass, or PVC rod have shown considerable promise as an economical and effective solution to many raptor electrocution problems, though tests of these guards are continuing.

PART FOUR: OTHER SELECTED MITIGATION METHODS. Direct impacts of power lines on raptors, other than electrocution, are commonly identified as line construction activities, maintenance impacts, increased vulnerability of perching and nesting raptors to harassment and persecution (e.g., shooting), increased chances of collisions between raptors and power lines, entanglement, noise disturbance, and field and corona effects.

The direct impacts of power line construction include: 1) loss of habitat through right-of-way clearing (where it is done), construction of access roads, and actual placement of poles, towers, and conductor pulling sites; and 2) disturbance of raptors through interference with courtship, nest building, incubation, and foraging activities which leads to desertion of nearby natural nests and roosts. When necessary, mitigation of these impacts may require preconstruction environmental assessment and planning, seasonal restrictions on the timing of construction, on-site analysis of raptor behavior at the time of construction in problem areas, salvaging deserted eggs or young birds by fostering them to other pairs away from the impacted area, making maximum use of existing roads and trails during line constructon, and constructing lines with the aid of helicopters rather than building new access roads in previously undisturbed areas.

The principal impact of line maintenance on raptors is the destruction, primarily to prevent power outages and electrical fires, of nests built on poles and towers. Pursuant to the Bald Eagle Protection Act, the Migratory Bird Treaty Act, and many State wildlife laws, it is illegal simply to destroy such nests. The most exciting successes in mitigating the effects of raptor nests on power line support structures involve: 1) moving problem nests to less dangerous places on the structures and 2) placing artificial nesting platforms in safe places on transmission towers or on dummy poles adjacent to energized lines.

Increased accessibility by man to previously undisturbed areas is usually the greatest long-term impact of power line construction on wildlife. This leads directly to shooting by indiscriminant hunters of perching and nesting raptors. Electrocution is highly selective (over 90 percent) against younger non-breeders; shooting, which is directed more at the general wintering population, does not discriminate to the same degree between adult breeders and subadult or immature non-breeders.

Both raptors and industry hardware (e.g., porcelain insulators) would suffer less shooting damage if power line corridors and roads were separated, where practicable, particularly in remote, otherwise undisturbed areas. If maintenance roads must be built underneath new power lines in previously inaccessible areas, road or trail closures should be implemented to minimize the access.

Collision of raptors with power lines is not a major problem, although where endangered species occur, some mitigation may be appropriate. Likewise, no significant impacts of electric or magnetic fields, or corona (e.g., noise, ozone) on perching and nesting raptors have been found.

The habitat enhancement value of power lines must be evaluated on a number of levels incuding: 1) local versus regional benefits to raptor populations; 2) direct versus indirect impacts (both negative and positive); 3) habitat diversity versus species abundance; and 4) aesthetics versus functionality. For example, functionally, a new power line may provide raptors with hunting perches and nesting places thereby increasing habitat diversity and raptor abundance; but, if it also increases the number of raptors that are shot, then the true habitat enhancement value may be lessened.

Most raptors which nest on power poles or transmission towers are species which inhabit open plains, prairies, or savannahs where trees and cliffs are absent and do not provide nest sites (Table 2). The Osprey is a notable exception. The success of power line nests varies from area to area and between species. Some have speculated that nesting on power poles and transmission towers is actually extending the breeding range of some raptors, but more often the result is a local increase of raptor density within a species' general range.

In any case, interest in artificial nesting platforms as habitat enhancement for raptors is very high. Actual installation of artificial nesting structures on power poles and transmission towers has been limited (Table 3), but the success of nest structure programs in general is promising.

An artificial nest structure design by Morlan W. Nelson (Figure 17) is of particular importance in that it was developed primarily for installation on power transmission towers. The design is intended to minimize construction time, use of materials, and, thus, cost per structure. Also, with features to protect nestlings from strong winds and intense sun, the structures could easily be modified into release stations for raptors for reintroducing them into areas where they have been extirpated.

PROLOGUE

Whereas cooperation between the electric utility industry, conservation organizations, and Federal agencies has reduced the occurrence of raptor electrocutions by power lines; and

whereas this cooperation illustrates the effectiveness of coordinated efforts in conserving an important wildlife resource;

Be it resolved that the participants of the 1975 Annual Meeting of the Raptor Research Foundation commend the electric utility industry for its collective efforts on behalf of raptors; further, the participants recommend that the industry continue this work.

Resolution passed at the 1975 Annual Meeting of the Raptor Research Foundation, Inc., Boise, Idaho.