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CREATING RAPTOR BENEFITS FROM POWERLINE PROBLEMS

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Powerlines benefit raptors by providing enhanced nesting and roosting sites. However, they also can kill raptors by electrocution and raptors can interfere with power transmission. The electrocution problem has been reduced by correcting existing lethal lines and implementing electrocution-safe designs for new lines. Remedial actions include pole modifications, perch management and insulation of wires and hardware. New line designs provide for proper insulation and adequate spacing of conductors and grounded hardware. Nesting platforms can reduce power transmission problems and enhance the benefits of nesting on powerlines. A combination of perch deterrents and insulator shields is a positive, cost-effective approach to managing bird contamination that allows birds to continue roosting on the towers.

Problems Affecting Raptors

Powerlines benefit raptors by providing enhanced perch sites for hunting (Olendorff et al. 1981). However, they can also adversely affect raptors (Olendorff et al. 1981, Williams and Colson 1989). In the U.S., raptor collisions with or entanglements in powerlines or tower lattices are not major problems (Olendorff et al. 1981, Olendorff and Lehman 1986) and shooting of raptors on utility poles appears to be less of a problem than electrocution (Peacock 1980, Benson 1982, APLIC 1996).

A raptor electrocution problem became apparent in the U.S. in 1971 (Olendorff et al. 1981). Concern stimulated testing of powerline designs that were safe for raptors (Nelson and Nelson 1977). This work culminated in the three editions of "Suggested Practices for Raptor Protection on Power Lines" (Miller et al. 1975, Olendorff et al. 1981, APLIC 1996) which provide guidelines for managing the electrocution problems.

At least 17 species of raptors have been electrocuted in the U.S. (Williams and Colson 1989). Large raptors are more susceptible to electrocution because they more easily span the distance between energized wires (Olendorff et al. 1981). Golden Eagles (*Aquila chrysaetos*) have been the most commonly electrocuted raptor, and most are subadults (Boeker and Nickerson 1975, Olendorff et al. 1981, Benson 1982, APLIC 1996, BLM, unpubl. data). The susceptibility of young eagles to electrocution may be due to their inexperience in flight (Nelson and Nelson 1977, Olendorff et al. 1981). Most Golden Eagle electrocutions apparently occur in winter (Benson 1982, PacifiCorp, unpubl. data). Inclement weather (rain, snow and wind) during winter increases the susceptibility of raptors to electrocution because of reduced flight maneuverability and increased conductivity of wet feathers (Olendorff et al. 1981).

The electrocution problem is more acute in grass and shrublands of the western U.S. and in areas where natural perches are scarce (Boeker and Nickerson 1975, Benson 1982, APLIC 1996). In the U.S., electrocutions are more prevalent on distribution lines (≤69 kV) than on high voltage transmission lines (Boeker and Nickerson 1975, APLIC 1996). Raptors are rarely electrocuted on transmission lines or low voltage lines (<1 kV, APLIC 1996).

Powerpole configuration influences the probability of raptor electrocution more than voltage alone (Williams and Colson 1989). Lethal configurations usually do not have adequate spacing between the phase conductors and ground wires or grounded hardware to prevent large raptors from touching them (Olendorff et al. 1981). Poles with additional hardware (i.e., transformers, switches, jumpers, other extra wires) are also lethal (Olendorff et al. 1981).

Certain powerpoles are preferred by eagles and have a greater probability of electrocuting birds (Nelson and Nelson 1977, Olendorff et al. 1981, Benson 1981, 1982). "Preferred" poles are either more elevated above the surrounding terrain or in

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areas with higher prey densities (Benson 1981). Pole arms that are diagonal or parallel to the prevailing winds tend to have a higher incidence of electrocutions (Nelson and Nelson 1977, Benson 1981, 1982).

Alleviation of the electrocution problem involves correcting existing lethal lines (pole modifications, perch management and insulation) and implementing new line designs that are safe for raptors. Objectives of these improvements are to provide adequate separation between energized wires and hardware and adequate insulation of wires and hardware where sufficient separation cannot be obtained. Modifying every pole along a line is cost-prohibitive and perhaps unwarranted from a biological prospective (Williams and Colson 1989, APLIC 1996). Action should focus on identifying and correcting chronically lethal poles (i.e., "preferred poles") and monitoring the success of the remedial action. Nelson and Nelson (1977) felt that most electrocutions could be prevented by correcting only about 2% of the poles.

The three-phase single-pole construction with a crossarm has been associated with most electrocutions (Olendorff et al. 1981, APLIC 1996). Methods to modify problem poles involve increasing conductor spacing and include (1) raising the center phase, (2) lowering the crossarm, (3) suspending the outer phases below the crossarm and (4) placing longer crossarms on the pole. The objective of these methods is to provide at least 152 cm separation between conductors (Olendorff et al. 1981, APLIC 1996).

The next most lethal configuration is a single-phase line with the conductor on top of the pole and a ground wire near the top insulator (Olendorff et al. 1981). The problem was solved by lowering the pole ground wire at least 30 cm below the top of the pole or cutting 10 cm gaps in the ground wires (Olendorff et al. 1981, APLIC 1996).

Elevated perches place birds above any danger and perch guards discourage raptors from perching on dangerous parts of powerpoles (Olendorff et al. 1981, APLIC 1996). They are used when adequate separation of wires and hardware cannot be obtained or when pole modification is infeasible. Perch guards are often used in conjunction with elevated perches.

Wires and other hardware are insulated on poles with wires connecting transformers and other pieces of equipment or when modifying poles is impractical (Olendorff et al. 1981, APLIC 1996). Insulation is often used in conjunction with elevated perches and is an economical option when only a few poles need modification (APLIC 1996).

The armless design is effective in minimizing raptor electrocutions provided there is adequate spacing (152 cm) between wires and hardware (APLIC 1996). This design is more expensive than the conventional crossarm designs, and it creates extra hazards to line crews (Olendorff et al. 1981). Certain 69-kV armless configurations once believed to be raptor-safe were recently found to be lethal to eagles due to grounding problems (APLIC 1996). The problem was resolved by placing perch guards on the top of the insulators or replacing insulator posts with longer ones (PacifiCorp, pers. comm.). Single-phase configurations should leave the top 50–75 cm of the pole free of wires or other hardware (APLIC 1996). Three-phase designs should provide adequate conductor spacing (152 cm) by using a taller pole and lower placement of the crossarm (APLIC 1996).

Underground construction is an obvious solution to the raptor electrocution problem. Although this practice is used in Europe and in urban areas of the U.S., it is considered too expensive for widespread application in rural areas of the U.S. (APLIC 1996). Underground lines also occasionally present design problems, particularly for high voltage transmission lines (APLIC 1996).

Nelson (1982) felt that the raptor electrocution problem in the U.S. had been reduced in the 1970s through cooperative efforts of government agencies, conservation organizations and the electric industry. It is debatable, however, whether electrocutions have decreased in recent years (APLIC 1996). However, awareness of the issue and efforts to resolve it have increased, and raptor electrocutions have decreased in areas where powerlines have been modified. Electrocution still occurs in the U.S., and it is a major problem in certain areas (APLIC 1996). Resolving electrocution problems is a continuing cooperative effort between the utilities and the regulatory agencies involving an "integrated management approach" (APLIC 1996). In this approach agencies and utility companies formally agree to action guidelines and standard operating procedures to identify and rectify problems.

POWER TRANSMISSION PROBLEMS

Powerlines benefit raptors and other large birds by providing enhanced nesting and roosting sites

(Engel et al. 1992, Steenhof et al. 1993). The benefits to nesting raptors are compromised by problems associated with power outages from nesting material, feces or electrocuted birds (Williams and Colson 1989, APLIC 1996). Roosting and perching birds can cause power outages where their fecal matter contaminates insulators (Michner 1928, Kaiser 1970, Sierra Pacific Power et al. 1988). The traditional solution to the problem was to remove nests (Stocek 1981). This is not a desirable solution because of legal and political ramifications (Olendorff et al. 1981). It is also ineffective because birds will often rebuild nests on the same or a nearby structure (Stocek 1981, Steenhof et al. 1993). Another approach is to discourage nesting, which is often used in conjunction with other efforts to enhance nesting opportunities (Stocek 1981, Williams and Colson 1989, APLIC 1996).

Nesting opportunities can be enhanced by relocating nests, modifying powerpoles and providing nesting platforms on the powerline structures (Stocek 1981, APLIC 1996). Relocating nests from powerlines to nearby trees or nesting platforms has been successful for Ospreys (*Pandion haliaetus*); however, sometimes birds will nest on another structure on the line (Stocek 1981, Austin-Smith and Rhodenizer 1983). Pole modifications (lowering crossarms, wires and hardware so birds can safely nest on top of the pole) are apparently effective but costly (Stocek 1981). The alternative to pole modifications is to place the nest on a platform and raise it safely above the wires (APLIC 1996).

Although nest platforms have been used on powerlines since the 1940s, few quantitative studies assessed their overall effectiveness (Olendorff et al. 1981). A 9-yr study on a new 500-kV transmission line in Idaho and Oregon by Steenhof et al. (1993) found that Golden Eagles and Ferruginous Hawks (*Buteo regalis*) apparently preferred the nesting platforms and had higher success rates on platforms. Raptor and Common Raven (*Corvus corax*) nesting success on transmission line towers was similar to, or higher than, that on surrounding natural substrates. In some cases, towers provided a more secure nesting substrate. The transmission line provided an opportunity for raptors and ravens to nest in areas where they had not before. The line was likely responsible for an overall increase in the number of breeding pairs. Steenhof et al. (1993) recommended that utility companies use platforms or tower modifications to safely attract raptors to specific towers or positions on towers and to enhance raptor productivity, and that nest removal was ineffective and unnecessary.

Historically, the approach to resolving problems associated with roosting raptors was either to deter birds from roosting over insulators or to shield the insulators from fecal contamination (Michner 1928). A comprehensive study in Idaho showed that the combination of shields and pegging can be a positive and cost-effective approach to managing bird contamination of insulators on high-voltage transmission lines (Young and Engel 1988, Engel et al. 1993). Although this study focused on Common Ravens, results may have application to raptors (vultures) that roost communally on powerline structures. Shields successfully protected central-string insulators from raven fecal contamination, and pegging effectively deterred ravens from roosting on outer portions of the tower crossarms. Treatments did not repel ravens from roosting on traditional towers, and they did not move to other towers. The effort significantly reduced bird-powerline problems but allowed birds to continue to roost on the towers.

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