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RAPTOR ELECTROCUTIONS AND ASSOCIATED FIRE HAZARDS IN THE SNAKE RIVER BIRDS OF PREY NATIONAL CONSERVATION AREA

by

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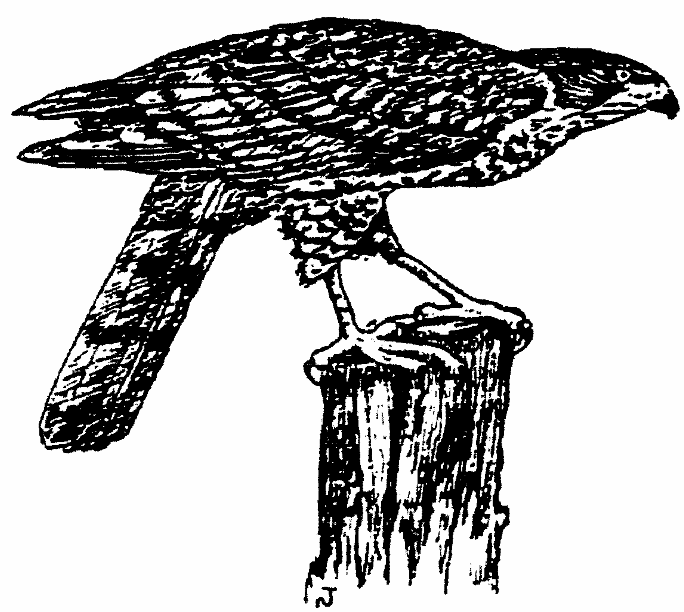

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RAPTOR ELECTROCUTIONS AND ASSOCIATED FIRE HAZARDS IN THE SNAKE RIVER BIRDS OF PREY NATIONAL CONSERVATION AREA

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Annual Report—FY 2000

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ABSTRACT

In 1999, we began an assessment of raptor electrocutions on power lines in and near the Snake River Birds of Prey National Conservation Area in southwestern Idaho. We produced a distribution line map of the study area in 1999, selected study segments, and began monthly searches for dead raptors along 19 segments totaling 61.2 linear km. From January-December 2000, we continued sampling at all 19 study segments. During initial searches in 1999, we found the remains of 24 dead birds below power poles. We found partially intact skeletons, scattered bones, and feathers of at least 23 individuals, and one intact golden eagle that had been electrocuted. In 2000, we found the remains of 23 additional birds along power lines in the study area, including 12 intact carcasses. Remains identified to species included 6 common ravens (*Corvus corax*), 1 bald eagle (*Haliaeetus leucocephalus*), 3 red-tailed hawks (*Buteo jamaicensis*), 2 rough-legged hawks (*Buteo lagopus*), 1 barn owl (*Tyto alba*), and 1 short-eared owl (*Asio flammeus*). One common raven showed signs of electrocution. Twenty-one sets of remains were found below 20 poles. Two birds also were found midspan between poles and may have been wire-strike victims. We found dead birds below 19 tangent poles and 1 pole in a deadend position. Pole-top configurations included simple crossarm, underbuilt, and compact designs. Additional hardware items on some poles included exposed jumper wires, transformers, capacitors, and electrical switches of several kinds. In 2001, we will continue sampling study segments each month. This spring, we will necropsy all intact carcasses recovered to date for which cause of death is unknown. Also, in 2001, we will initiate a carcass removal study to determine if scavenging will affect estimates of electrocution rates.

INTRODUCTION

In 1999, we began an assessment of raptor electrocution on power lines in and near the Snake River Birds of Prey National Conservation Area (NCA) in southwestern Idaho. The study is a cooperative effort by the U.S. Bureau of Land Management (through its Challenge Cost Share Program), Idaho Power Company, and U.S. Geological Survey.

The goals of the project are to estimate raptor electrocution rates and identify electrocution hazards in the NCA. Because raptor electrocutions are potential ignition sources for wildfires, we also are addressing the fire management implications of the raptor electrocution problem. Eventually, this will allow the Idaho Power Company to develop a program for mitigating raptor electrocutions and reducing fire potential in the NCA.

During the first year of the study (1999), we produced a distribution line map of the study area, selected study segments, and began searching for dead raptors along 19 segments totaling 61.2 linear km (Lehman and Barrett 2000). Study segments are located in the relatively undeveloped interior of the NCA (4 segments of variable lengths), and along the borders and private inholdings of the NCA where agriculture and associated power line developments are common (15 2-km segments). From September-November 1999, we visited all study segments to remove remains of birds killed prior to this study. In December 1999, we began regular, monthly sampling for recent mortalities.

This report provides an update of activities and findings for the second year of our study. In 2000, we continued monthly sampling at all 19 study segments. Here we present mortality data for 2000, and discuss plans for 2001. We also show how the NCA study is being integrated into a regional study of raptor electrocutions being conducted as part of the senior author's Ph.D. dissertation.

STUDY AREA

Our research is being conducted on the NCA's benchlands north of the Snake River Canyon, Ada and Elmore counties, Idaho (43∀N, 116∀W) (Fig. 1). Topography on the benchlands is flat to slightly rolling with scattered, isolated cinder cones and buttes. Elevation ranges from 920 m at the canyon rim to 1,066 m at the highest point. Vegetation in undisturbed areas is dominated by big sagebrush (*Artemisia tridentata*), shadscale (*Atriplex confertifolia*), and winterfat (*Krascheninnikovia lanata*) (Kochert and Pellant 1986). In areas where surface-disturbing activities or wildfires have occurred, vegetation is dominated by cheatgrass (*Bromus tectorum*), Russian thistle (*Salsola kali*), and other non-native annual plants (Yensen 1982). Primary land uses in and adjacent to the NCA include farming, grazing, outdoor recreation, and military training (U.S. Dept. Int. 1995). Approximately 17,982 ha of privately owned land within the NCA boundaries, and many private holdings outside the NCA, have been developed for agriculture, primarily irrigated cropland and pasture (U.S. Dept. Int. 1996).

BACKGROUND

The NCA supports one of the highest densities of non-colonial nesting raptors in the world (U.S. Dept. Int. 1979, Olendorff et al. 1989). Recent studies indicate that habitat conversions due to wildfires, in combination with other disturbances, are having serious effects on some raptor species in the NCA (U.S. Dept. Int. 1995). The golden eagle (*Aquila chrysaetos*) and prairie falcon (*Falco mexicanus*), in particular, have experienced significant population declines in recent years (Steenhof et al. 1997, Lehman et al. 1998, Steenhof et al. 1999).

Conversion of native shrub habitats to non-native annual grasslands is one of the most important management issues in the NCA. During the late 19th century, exotic annual plantsˈ most notably cheatgrass (*Bromus tectorum*)ˈ began to invade the American West (Yensen 1981). Cheatgrass grows in dense patches, dries out earlier than native bunchgrasses during the summer, and is highly flammable (Pellant 1990, Peters and Bunting 1994). As a result, today wildfires in infested areas are more frequent and burn larger areas than under native conditions (Whisenant 1990). These altered fire conditions have led to conversion of >50% of the NCA's native plant communities (Kochert and Pellant 1986, U.S. Dept. Int. 1995).

Habitat conversions and raptor electrocutions are linked because electrocuted birds are a possible source of fire ignitions. Currently, little is known about electrocution risks in the NCA. What is known is that electrocution of large birds, including raptors, common ravens (*Corvus corax*), and great blue herons (*Ardea herodius*), have resulted in at least 26 fire starts in BLM's Lower Snake River District since 1976 (U.S. Dept. Int. unpubl. data). Six of these were in the NCA; and one, the 3,700-ha Sinker Butte Fire, destroyed a significant portion of the NCA's remaining shrublands in 1996.

OBJECTIVES

Our overall objective is to reduce electrocution risks and fire hazards in the NCA by identifying specific poles and pole designs that are hazardous to raptors and other large birds. Specific objectives of the study are:

1) Estimate raptor electrocution rates (deaths/km/month) along selected stretches of distribution lines.

2) Identify hazardous pole designs and compare electrocution rates (deaths/pole/month) among pole types.

3) Evaluate fire hazards along all distribution lines sampled.

4) Evaluate ecological and other factors that may contribute to electrocution hazards in the NCA.

METHODS

To assess electrocution risks and estimate rates of electrocution, we are searching for dead birds along selected power line stretches in and near the NCA. We are sampling in two areas: the relatively undeveloped interior of the NCA; and along the borders of the NCA where private inholdings and associated power line developments are common. Our intent is to sample selected stretches (hereafter called study segments or study sites) in both areas each month for a minimum of two years. This will allow detection of differences in electrocution rates in developed and undeveloped areas, as well as seasonal differences during three raptor concentration periods: nesting, postfledging, and wintering. In developed areas, we are focusing on agricultural developments (irrigated cropland and pasture), because raptors often are observed foraging in these areas (U.S. Dept. Int. 1996) and often use power poles as hunting perches.

To produce a power line map of the NCA, we used an ARC/INFO Geographic Information System (GIS) (Environmental Systems Research Inc. 1993) to overlay a distribution line grid, provided by Idaho Power, onto a map of the NCA showing landownership, roads, and major topographic features. The distribution grid showed the configuration of 1-phase, 2-phase, and 3-phase lines. During August and September 1999, we randomly checked the accuracy of the distribution grid to establish that power lines were correctly shown and to assess which inholdings contained agricultural developments. Some power lines were added to the grid as a result of ground truthing efforts.

The completed power line map showed that most distribution lines in and near the NCA are 3-phase lines. Two-phase lines are rare, and 1-phase lines usually consist of short (<1 km) feeder lines to private farms and residences. As a result, we are limiting power line searches to 3-phase lines. The map also showed that 3-phase lines bordering the NCA consist of many relatively short stretches that follow county roads and other public and private thoroughfares. In contrast, 3-phase lines penetrating the interior of the NCA consist of a few relatively long, unbroken stretches connecting production facilities and substations to distribution networks outside the NCA.

To select interior study sites, we delineated all 3-phase distribution lines within the boundary of the NCA into segments of varying lengths depending on landownership and patterns of agricultural development. To be included as a possible study site, a segment had to be at least 2 km long and both end points had to lie ∅1 km from the NCA boundary, or in the case of private inholdings, ∅1 km from any agricultural development. This allowed us to retain segments near undeveloped private inholdings. Four segments ranging in length from 2.3-15.9 km satisfied these criteria. We selected all four as study segments (Table 1, Fig. 1). From 28 September-6 November 1999, we visited each segment to remove the remains of birds killed prior to this study.

To select border sites, we delineated most 3-phase distribution lines on and near the NCA boundary, and those in and adjacent to inholdings within the NCA, into 2-km-long segments. We considered segments outside the NCA as potential study sites if at least one endpoint was Ω2 km from an NCA boundary. We considered segments inside the NCA if no part of the segment extended >1 km into the NCA. This prevented overlap of border and interior sites. To be considered, each 2-km segment had to occur Ω1 km from an agricultural development. Seventy-two segments met the selection criteria. These were randomly ordered and assigned to a primary list of 15 study segments and a back-up list of 57 segments. From 29 October to 21 November 1999, we attempted to contact private landowners and visited each of the 15 primary sites to remove any bird remains present. We rejected four segments from the primary list because landowners denied us access or the segments could not be located. Two additional segments were rejected because Idaho Power modified poles in these segments after sampling had begun. To ensure a minimum of 15 study segments, we selected six replacement sites from the backup list in the original random order (Table 1, Fig 1).

After all segments had been visited to remove mortalities that occurred prior to this study, we began regular monthly sampling at all 19 study segments. Monthly sampling began in December 1999 and continued through December 2000.

Search areas within study segments consisted of a circular plot with a 10-m radius centered on each power pole. There was no minimum or maximum search time; we searched each plot until we felt that all carcasses had been found. When carcasses were found, we attempted to determine cause of death visually by the presence of burned feathers or feet, gunshots wounds, or other distinguishing marks. All carcasses were collected for later identification to species. We recorded the pole-top configuration for all poles where dead birds were found, and in each case photographed the pole. Pole-top configurations were distinguished by conductor configuration, grounding hardware design, and the presence of jumper wires and additional hardware (e.g., tranformers, electrical switches, reclosers, cutout arrestors).

To assess fire hazards and determine if electrocution rates vary by habitat type, we characterized vegetation within a 100-m wide strip on both sides of each study segment. This allowed an assessment of fire risk at each study site and a determination of how well the surrounding vegetation might propagate a fire after ignition. We classified vegetation within the strips as shrubland, disturbed/grassland, mixed shrub/grassland, recent burn (still blackened), bare ground, or greenstrip. We defined areas in which percent cover of shrubs was ∅60% as shrub sites. Areas where percent cover of native and non-native grasses was ∅60% were classified as disturbed/grassland sites. Areas where shrub and grass cover was about the same were classified as mixed shrub/grassland sites.

SUMMARY OF 1999 RESULTS

During initial searches in 1999, we found partially intact skeletons, scattered bones, and feathers of at least 19 birds. In December, when we began sampling for recent kills, we found five additional dead birds, including a freshly electrocuted golden eagle. Of the 24 birds found during both surveys (Table 2), we were able to identify 6 common ravens (*Corvus corax*), 2 red-tailed hawks (*Buteo jamaicensis*), 2 American kestrels (*Falco sparverius*), 1 northern harrier (*Circus cyaneus*), 1 golden eagle, and 1 barn owl (*Tyto alba*). Only the golden eagle showed clear signs of electrocution, but most remains were too old to establish cause of death. All 24 sets of remains were found below 21 poles (Table 3). We found dead birds below 18 tangent poles and three poles in deadend and corner positions. Pole-top configuations included simple crossarm, underbuilt, compact, and H-frame designs. Additional hardware items on many poles included exposed jumper wires, transformers, capacitors, and electrical switches of several kinds.

RESULTS: 2000

Raptor Mortalities

In 2000, we found the remains of 23 dead birds below power lines in the NCA (Table 4, Appendix I). Five birds were found incidentally below poles that are not in our study segments. Of 18 individuals found within our study segments, 12 were at border sites, and 6 were at interior sites. Of 23 birds found, 14 were identified to species. These included 6 common ravens, 1 bald eagle (*Haliaeetus leucocephalus*), 3 red-tailed hawks, 2 rough-legged hawks (*Buteo lagopus*), 1 barn owl, and 1 short-eared owl (*Asio flammeus*). Twelve individuals found below poles this year were whole, intact carcasses. Remains of 11 individuals consisted of body parts and feathers. The latter may represent birds missed in previous surveys, prey items, or birds that were scavenged prior to our visits.

One bird in our sample (a common raven) showed clear signs of electrocution (burns on legs). Two additional sets of remains were found midspan between poles. One, an intact bald eagle, was found between two poles near C.J. Strike Reservoir, and probably died by striking one or more conductors. An unidentified bird (feather pile) was found between two poles on a study segment near Mountain Home.

Of 23 mortalities documented in 2000, 12 occurred from January to March. We documented nine mortalities from April to June, and two mortalities from October to December. We found no mortalities during the summer months (July to September).

Pole Type and Configuration

Twenty-one sets of remains were found on or below 20 poles. In one case, we found two sets of remains under the same pole (Segment B-25, Pole 10) (Appendix I). We recovered remains below three poles in both 1999 and 2000 (B-6, Pole 4B; B-25, Pole 3; and Victory, Pole 141) (Appendix I).

We found dead birds below 19 tangent poles and one pole in a deadend position (Table 5). Among these poles, hardware design (pole-top configuration, grounding, and related hardware) varied. We found birds under poles with three basic pole-top designs: simple crossarm, underbuilt, and compact. Fifteen poles had one crossarm (simple crossarm design), and two had underbuilt designs with one additional crossarm (with conductors). Two poles had compact designs, and one was a combination compact/underbuilt design. In all cases, grounding hardware consisted of a ground wire extending vertically up the pole to a horizontal neutral line.

Additional hardware items, including exposed jumper wires, pole-top switches, fuse disconnect switches, transformers, and capacitors, were present on five poles. Three poles had exposed jumper wires (Table 5). In two cases, jumper wires connected the conductors to transformers, and in one case the jumper wires connected conductors to a capacitor bank. In all three cases where jumper wires were present, fuse disconnect switches also were present. Finally, two poles had pole-top switches with no additional hardware.

Habitat Types

At border sites, agriculture was the most frequent habitat feature recorded (Table 1). Fourteen of 15 border sites were directly adjacent to croplands or irrigated pasture. In 13 cases, agriculture was the dominant habitat type. However, other habitat types, including shrubland, disturbed/grassland, and mixed shrub/grassland were intermixed with agriculture in most cases.

As expected, we recorded no agricultural developments at the four interior sites (Table 3). Shrublands predominated at two of these sites, and mixed shrub/grassland predominated at one site. The fourth interior site showed a mixture of habitat types. In this case, the longest of the four interior sites, shrublands, disturbed/grasslands, and mixed shrub/grasslands all occurred within the study segment.

Nests and Pole Fires

In 2000, we documented nesting by common ravens on five occasions, two of which resulted in pole fires. On 15 March, we observed ravens using a nest on Pole 149 in the Victory study segment near Swan Falls. On 13 April, we found Pole 149 burning just below the cross arm. The fire probably occurred when sticks from the nest came in contact with two conductors or a conductor and a ground wire. Idaho Power was called and a crew was dispatched to the site. By the time the crew arrived, the pole had burned all the way through, leaving the cross arm suspended between neighboring poles. Fortunately, the pole fire did not result in fire on the ground.

On 18 April, we found the remains of a burned nest on a transformer bank on Pole 479 along the C.J. Strike study segment. The transformers were blackened and the associated jumper wires were burned through and hanging from the above crossarm. We did not witness this fire, but assume that sticks from the nest were ignited by contacts between jumper wires leading to the transformers. Again, fortunately, this fire did not reach the ground.

DISCUSSION AND PLANS FOR 2001

Our results indicate that mortality of raptors, ravens, and other birds on power lines in and near the NCA occurs at least occasionally, and perhaps regularly in the winter and spring. Before regular sampling began in December 1999, we confirmed at least 19 mortalities that occurred prior to our study (Lehman and Barrett 2000) (Appendix I). An additional 28 mortalities occurred since regular sampling began in December 1999 (for a total of 47 mortalities since the study began). However, any conclusions regarding electrocution mortality would be premature. To date only two electrocutions have been confirmed, though others probably will be verified when necropsies are complete (see below). Necropsies also are likely to confirm that some birds found below power poles in the study area were shot. In several cases in 1999, we found spent shell casings near poles where dead birds were found. Other birds in our samples may have died of causes other than electrocution or shooting. A few remains probably represent prey items consumed by raptors or ravens while perched on pole tops.

Fire risk appears to be greatest in the interior of the NCA. Here, power lines tend to occur within stands of native and non-native plant communities that are naturally vulnerable to wildfires during the dry season (summer and early fall). In contrast, at border sites irrigated agriculture is common and fire risks are relatively low. We are particularly concerned about electrocution risks and fire hazards at two interior sites (Victory and Swan Falls) where many of the remaining stands of native shrubs in the NCA occur (U.S. Dept. Int. 1996), and where we confirmed two pole fires in 2000. These two sites also are near reaches of the Snake River Canyon where raptor population densities are very high.

In 2001, we will continue sampling all 19 study segments each month. Sampling will continue at least through December 2001. In 2001, we will also continue attempts to identify remains of birds collected in 1999 and 2000. We will contact universities in nearby western states to determine if avian bone collections might be available for cross referencing with the skeletal remains of birds recovered during our study. Boise State University has no such collection, but does have a good collection of raptor study skins that can be used to identify feather remains. Recently, we contacted the Veterinary Teaching Hospital at Colorado State University to arrange for necropsies of intact carcasses for which cause of death has not been determined. Necropsies are scheduled to begin this spring. In 2001 we also intend to initiate a carcass removal study to assess the degree to which scavenging by predators will ultimately affect our estimates of raptor electrocution rates. Finally, in 2001 we will cooperate with Idaho Power to begin retrofitting poles where electrocutions have been confirmed. Retrofitted poles will then be monitored throughout the year to evaluate the effectiveness of retrofits.

INTEGRATION WITH OTHER WORK

This work will form part of the senior author's Ph.D. dissertation project at Colorado State University, Fort Collins. As part of that work, we plan to expand sampling to include other areas of the western U.S. In June 2000, data collection will begin in a second study area in northwestern Colorado and northeastern Utah under a grant from the U.S. Fish and Wildlife Service. We hope to initiate sampling in other study areas as well.

The NCA study will contribute to at least two of the four components of a conceptual model developed for Lehman's dissertation project (Lehman 2000) (see Fig. 2). Random sampling of power poles will allow us to examine patterns of electrocution with greater accuracy than in the past (scope), and sampling of retrofitted poles will allow us to assess the effectiveness of current standards for raptor-safe construction (monitoring). Data from more than one study area also could provide opportunities to model the effects of electrocution mortality on populations, and to explore new approaches to identifying and targeting high risk areas (e.g., with GIS models).

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Table 1. Location and characteristics of 19 study segments in and near the NCA.

Study Segment	Location (County)	Length (Km)	No. of Poles	Habitat Types[1]
<u>Border Sites</u>				
B-3	Elmore	2	13	SH, GR, AG
B-5	Elmore	2	22	AG, GR, SH
B-6	Elmore	2	21	AG, GR
B-13	Elmore	2	20	AG, GR
B-15	Elmore	2	21	AG
B-19	Elmore	2	20	AG, GR
B-25	Elmore	2	22	AG, SH, MSG, WT
B-28	Elmore	2	32	AG, SH, MSG
B-34	Elmore	2	19	AG, MSG
B-35	Elmore	2	23	AG, MSG
B-36	Elmore	2	21	AG, MSG
B-39	Elmore	2	19	AG, SH, GR
B-41	Elmore	2	20	AG, MSG
B-48	Ada	2	21	AG, GR
B-52	Elmore	2	23	MSG
<u>Interior Sites</u>				
Victory	Ada	10	63	SH
Swan Falls	Ada	3	30	SH
Bruneau	Elmore	2.3	23	MSG
C.J. Strike	Elmore	15.9	179	GR, SH, MSG

[1]SH = Shrub; GR = Grass; MSG = Mixed Shrub/Grass; AG = Agriculture; WT = Water. The order habitat codes are presented reflects the relative dominance of each habitat type.

Table 2. Species and species categories of birds found under distribution lines in the NCA in 1999.

Species /Species Category	No. Found Sept. - Nov.	No. Found Dec.	Totals
Border Sites			
Common Raven	2	1	3
American Kestrel	1	1	2
Red-Tail Hawk	1	1	2
Golden Eagle	-	1	1
Northern Harrier	-	1	1
Unidentified Eagle	1	-	1
Unidentified Raptor	1	-	1
Unidentified Bird	3	-	3
Totals	9	5	14
Interior Sites			
Common Raven	3	-	3
Barn Owl	1	-	1
Unidentified Hawk	1	-	1
Unidentified Eagle	3	-	3
Unidentified Bird	2	-	2
Totals	10	-	10

Table 3. Pole design and configuration for 21 3-phase distribution poles where dead birds were found in and near the NCA in 1999.

Pole Type and Configuration	No. of Poles
Pole Position	
Tangent	18
Corner	1
Corner/Deadend	2
Total	21
Pole-Top Configuration	
Simple Crossarm	8
Underbuilt	9
Compact Design	2
H-Frame	2
Total	21
Static Line	
Not Present	2
Present	19
Total	21
Additional Hardware[1]	
No Additional Hardware	8
Exposed Jumper Wires	7
Pole-Top Switches	2
Fuse Disconnect Switches	3
Transformers	4
Capacitors	1

[1]Does not total to 21 because some configurations had several types of additional hardware.

Table 4. Species and species categories of birds found under distribution lines in the NCA in 2000.

Species /Species Category	No. Found Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Totals
<u>Border Sites</u>					
Common Raven	2	2	-	-	4
Red-tailed Hawk	1	1	-	-	2
Rough-legged Hawk	1	-	-	-	1
Barn Owl	1	-	-	-	1
Short-eared Owl	-	-	-	1	1
Unidentified Eagle	1	-	-	-	1
Unidentified Bird	1	-	-	1	2
Totals	7	3	0	2	12
<u>Interior Sites</u>					
Common Raven	1	1	-	-	2
Bald Eagle	1	-	-	-	1
Rough-legged Hawk	-	1	-	-	1
Unidentified Owl	-	2	-	-	2
Totals	2	4	0	0	6
<u>Incidental Mortalities</u>					
Red-tailed Hawk	-	1	-	-	1
Unidentified Eagle	1	-	-	-	1
Unidentified Hawk	-	1	-	-	1
Unidentified Owl	1	-	-	-	1
Unidentified Bird	1	-	-	-	1
Totals	3	2	0	0	5
Grand Totals	12	9	0	2	23

Table 5. Pole design and configuration for 21 3-phase distribution poles where dead birds were found in and near the NCA in 2000.

Pole Type and Configuration	No. of Poles
<u>Pole Position</u>	
Tangent	19
Deadend	1
Total	20
<u>Pole-Top Configuration</u>	
Simple Crossarm	15
Underbuilt	2
Compact Design	2
Compact with Underbuild	1
Total	20
<u>Static Line</u>	
Not Present	0
Present	20
Total	20
<u>Additional Hardware</u>[1]	
No Additional Hardware	15
Exposed Jumper Wires	3
Pole-Top Switches	2
Fuse Disconnect Switches	3
Transformers	2
Capacitors	1

[1]Does not total to 20 because some configurations had several types of additional hardware.

POWER LINE MORTALITIES IN THE NCA: 1999-2000

Date[1]	Study Segment[2]	Pole #	Species[3]	Cause of Death[4]	Description of Remains
1999					
28 Sept.	Victory (I)	135	CR	unk	Partial skeleton and feathers.
28 Sept.	Victory (I)	141	UH	unk	Partial skeleton with skull (no lower mandibles), feathers.
28 Sept.	Victory (I)	141	UB	unk	Partial skeleton mixed with above bird.
28 Sept.	Victory (I)	162	CR	unk	Skull only (no lower mandible).
29 Sept.	Swan Falls (I)	38	UB	unk	Partial skeleton. Possible prey remains.
2 Nov.	B-64	13	UR	unk	Broken skull (no lower mandible), partial skeleton.
3 Nov.	B-3	518	UB	unk	Few bones. Possible prey remains.
3 Nov.	B-3	521	UE	unk	Nearly complete skeleton (no beak or lower mandible), feathers.
5 Nov.	C.J. Strike (I)	452	UE	unk	Upper portion of skull (no beak or lower mandible).
6 Nov.	C.J. Strike (I)	319	BO	unk	Feathers.
6 Nov.	C.J. Strike (I)	326	UE	unk	Partial skeleton, feathers.
10 Nov.	C.J. Strike (I)	380	UE	unk	Single bone and single talon.
10 Nov.	C.J. Strike (I)	388B	CR	unk	Few feathers.
17 Nov.	B-5	13	RT	unk	Feathers and partial skeleton.
17 Nov.	B- 6	4B	CR	unk	Skull and partial skeleton (no lower mandible).

Date[1]	Study Segment[2]	Pole #	Species[3]	Cause of Death[4]	Description of Remains
17 Nov.	B-6	4B	CR	unk	Skull, feathers, partial skeleton.
21 Nov.	B-52	2	UB	unk	Few bones.
27 Nov.	B-25	3	AK	unk	Few feathers. Male.
1 Dec.	B-3	521	UB	unk	Few bones.
3 Dec.	B-52	4	AK	unk	Part of a wing. Female.
13 Dec.	Swan Falls	32	UB	unk	Part of wing, few bones.
14 Dec.	B-48	8	GE	E	Fresh carcass of adult turned into FWS.
14 Dec.	B-48	8	UE	unk	Bone pile found by Idaho Power.
14 Dec.	B-66[5]	5B	RT	unk	Feathers and few bones.
14 Dec.	B-64[5]	12	NH	unk	Feathers, skull, partial skeleton (no lower mandible).
27 Dec.	B-39	2	CR	unk	Feathers only.
2000					
24 Jan.	B-54	10	UB	unk	Bones only.
24 Jan.	B-54	10	CR	unk	Skull and bones.
24 Jan.	B-54	14	BO	unk	Bones and feathers.
24 Jan.	R-1	--	UB	unk	Eagle sized bones mixed with other unidentified bird bones.
26 Jan.	B-25	3	UE	unk	Old bones, a few weathered feathers.
26 Jan.	C.J. Strike(I)	352-353	BE	C	Fresh carcass with breast scavenged. Found midspan. Probable collision.

Date[1]	Study Segment[2]	Pole #	Species[3]	Cause of Death[4]	Description of Remains
17 Feb.	R-2	--	UB	unk	Feather pile only.
24 Feb.	B-6	4B	CR	E	Full carcass, burns on left leg.
15 Mar.	R-4	--	UO	unk	Old carcass.
15 Mar.	Victory(I)	139	CR	unk	Whole carcass.
15 Mar.	B-48	18	RL	unk	Whole carcass.
30 Mar.	B-36	18	RT	unk	Whole carcass of adult.
18 Apr.	Victory(I)	127	CR	unk	Whole carcass.
18 Apr.	R-5	--	RT	unk	Whole carcass.
18 Apr.	R-6	--	UH	unk	Whole carcass.
20 Apr.	Bruneau(I)	19	UO	unk	Wings and feathers.
18 May	Victory(I)	156	UO	unk	Wings and legs only of small owl. Found under CR nest.
18 May	Victory(I)	141	RL	unk	Whole carcass.
24 May	B-15	15	CR	unk	Fresh carcass, bleeding from beak. Other primaries gone from one wing.
30 May	B-48	11	CR	unk	Whole carcass.
28 June	B-6	3	RT	unk	Whole carcass of immature.
1 Nov.	B-6	15	SO	unk	Feathers only.
27 Dec.	B-13	9-10	UB	unk	Feathers only.

[1]Date found.
[2]I = Interior site; B = Border site; R = Random pole.
[3]CR = Common Raven; BO = Barn Owl; RT = Red-tailed Hawk; AK = American Kestrel; GE = Golden Eagle; NH = Northern Harrier; RL = Rough-legged Hawk; SO = Short-eared Owl; UB = unidentified bird; UH = unidentified hawk; UE = unidentified eagle, UO=unidentified owl.
[4]unk = unknown; E = electrocution; C = collision.
[5]Segment rejected after Idaho Power retrofitted poles in segment.

Figure 1. Location of the Snake River Birds of Prey National Conservation Area and 19 distribution line segments selected for study.

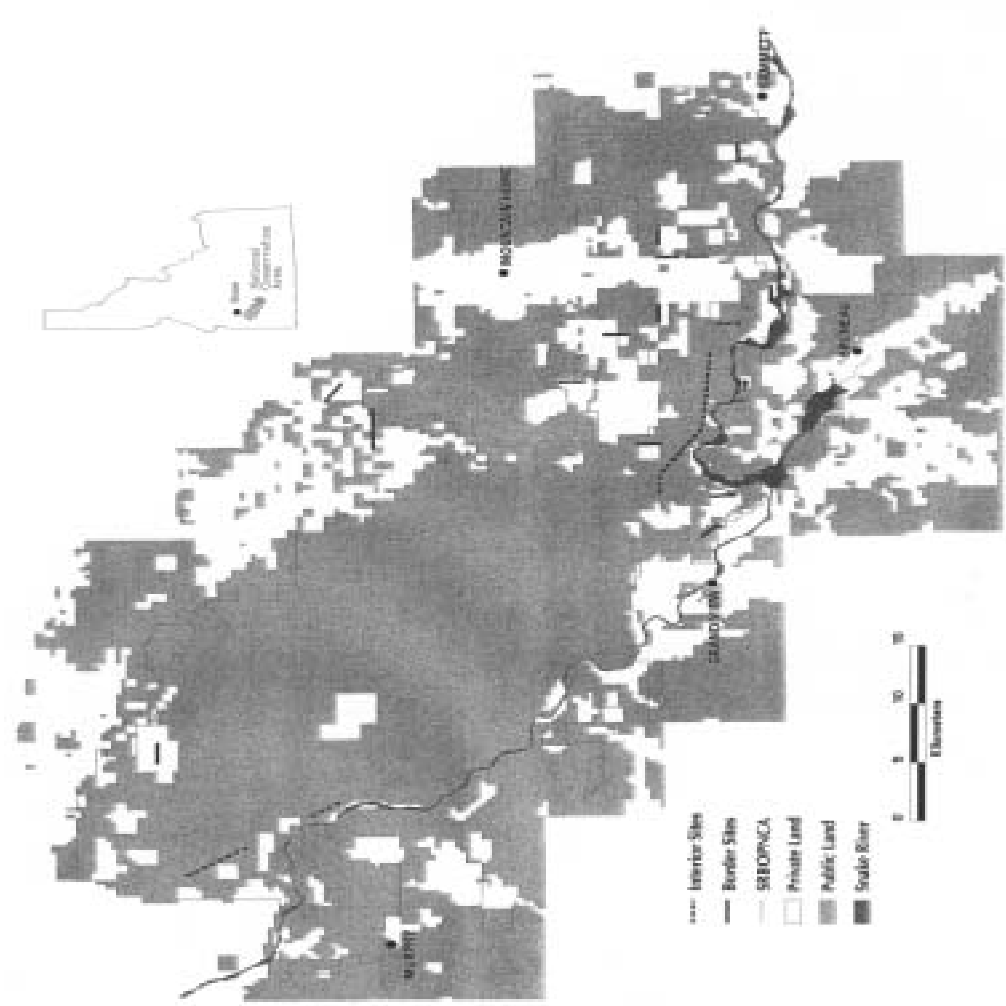
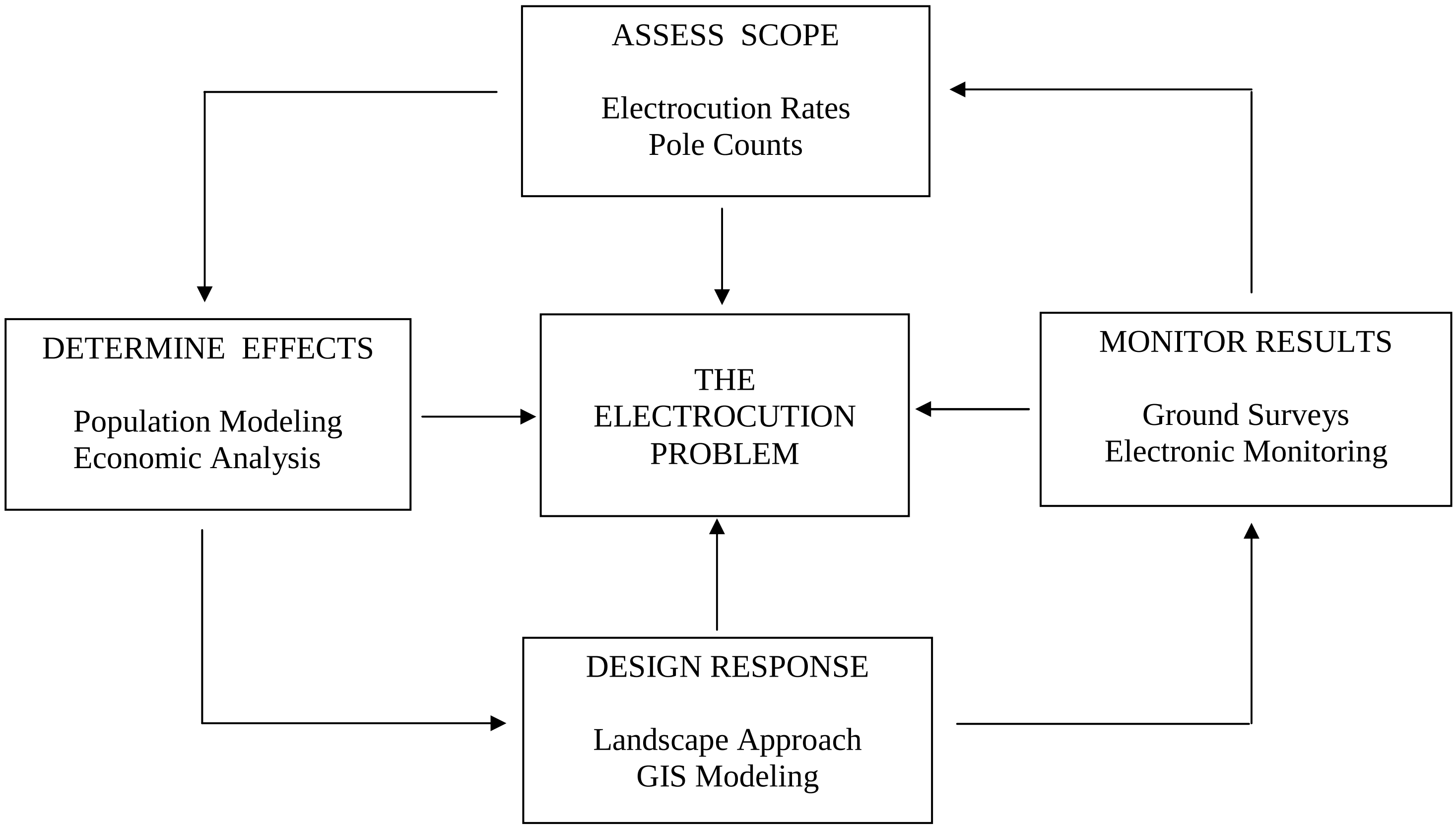


Figure 2. Schematic showing components and methods for a long-term study of raptor electrocutions. The primary objective is to reduce mortality to its lowest possible level in the shortest time frame possible at all scales (local, regional, national).



The sampling unit in this study would be an individual utility. Utilities would be stratified based on utility type, landscape, and/or biological factors. A minimum of 20 utilities would be included in the study so that 4-5 utilities would be represented in each stratum. In each case, the four study components outlined above would be addressed. Based on the results, we would build a landscape model allowing us to "fit" utilities not included in the study. The model would allow those utilities to estimate the scope and nature of their electrocution problems, and to plan and implement effective mitigation and monitoring. Ultimately, the study would produce the data necessary to build a population model showing the likely impacts to raptors over the long term if we ignore the problem. Hopefully, the economic analysis would demonstrate that the long-term costs of electrical outages are higher than the short-term costs of retrofitting. Finally, the study would provide the opportunity to explore new approaches to monitoring the problem, including electronic capture of electrocution data.