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A Study of the Risk of Collision with Power Lines by Waterbirds in Winter at Shotton Steel Works, North Wales

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1. EXECUTIVE SUMMARY

1.The aim was to investigate the impact of power lines at Shotton (North Wales) on waterbirds wintering on the lagoons and on birds crossing the power lines to reach nearby habitats.

2.Systematic observations were made of all waterbirds attempting to cross the power lines. Their direction and height of flight, together with weather variables were recorded. Surveys were also made of the ground beneath the power lines in order to look for casualties.

3.In total, 3,957 birds were observed crossing the wires. Wildfowl and Gulls were the most frequently recorded groups of species. Frequency of crossings peaked in September for all species groups except Gulls which peaked in mid-winter. Gulls, Wildfowl, Cormorants and Herons tended to cross in smaller groups than Waders. Half the observations involved birds flying straight over the power lines and making no use of the lagoons.

4.The main directions of travel were related to the birds' feeding and roosting areas. The majority of birds of all groups crossed the power lines above the top earth wire, and only a small proportion were recorded flying either through or beneath the power cables. Up to 3.8% of birds came within 1 m of the cables. The spans to the north-west of the lagoons were crossed most frequently.

5.One Mallard wing was found beneath the power lines but it was not known if this was a collision casualty or not. One Mute Swan was seen to strike the power lines and fall but survived and one diverted at a late stage, this represents 14% of the species seen to cross. In general, mortality rate of waterbirds due to collisions with wires was considered to be low.

6.The impact of the power lines on the mortality rate of waterbirds at Shotton is discussed.

2. INTRODUCTION

This study together with a previous study on Common Tern *Sterna hirundo* (Henderson *et al.* 1995) was implemented in order to investigate the potential impact of power lines on local bird populations at Shotton.

Studies have shown that power lines may pose a threat to wide range of birds (Borell 1939, Scott *et al.* 1972). Birds have been at risk either from collision with the power lines (Anderson 1978) or, in larger species, from electrocution where their wings can span two parallel wires (Fielder & Wissner 1980, Orloff *et al.* 1992). A more detailed literature review of bird mortality due to power lines appears in Henderson *et al.* (1995).

The aim of the present study was to determine the impact of power lines on waterbirds which either wintered on the lagoons or crossed the power lines between the estuary and inland habitats. Waterbirds include all wetland dependant families of birds such as gulls, ducks, swans, cormorants and waders.

A total of 18 species of waterbird was recorded crossing the power lines during the study period September 1994 to March 1995. Birds were recorded throughout the day, but particularly during the early morning and late afternoon. Procedure and techniques were as those used in the Common Tern study (Henderson *et al.* 1995).

3. METHODS

3.1 Study site

Observations were based in the vicinity of a series of water-filled lagoons situated within the industrial complex of Shotton Steelworks, on Deeside, North Wales (OS 296 707). Surrounding the lagoons is wasteland which gives way to saltmarsh to the north and west (Fig. 1).

Waterbirds flying to and from the estuary need not cross any industrial construction, except for power lines. In addition, some waterbirds using nearby inland pools and reservoirs cross industrial construction and power lines to reach the lagoons. Two sets of power lines run west of the lagoons towards the River Dee and in doing so act as potential obstacles which the waterbirds must cross on their journeys to and from the estuary. Those waterbirds moving between inland water complexes to the north of the National Power plant and the study site lagoons must cross one set of power lines (Fig. 2). The estuary is approximately 5 km to the north-west of the lagoons.

The nearest power line to the lagoon (line 1) is approximately 100 m from the lagoons at its closest point. Line 1 carries 132 kV on cables between 6.7 m and 26 m high (the height of the pylon). Line 1 comprises six groups of four closely held cables plus an earth cable running from the top of each pylon. The groups of cables are 2.8 m apart. Line 1 consists of wire spans 1, 2 and 3 as illustrated on Fig. 1.

Line 2 was erected in late 1993 and carries 400 kV and is approximately 200 m away from the lagoons at its nearest point. It is almost twice as high as line 1 but carries fewer cables (three groups of two, plus an earth line) with 5.7 m distance between cable groups. The pylons rise to 46 m and at their lowest point the power cables are 7.6 m above the ground. Line 2 consists of wire spans 4, 5 and 6 as illustrated on Fig. 1.

3.2 Data collection

Systematic observations were made of all waterbirds attempting to cross the power lines. On most days counts were made from dawn until dusk.

For each waterbird crossing either line 1 or line 2 we recorded the following criteria:

1. Direction of journey.

2. Whether the bird passed over, under or between the wires.

3. The estimated height in metres of the bird when crossing above the top earth wire.

4. Whether a bird approached a group of power lines either level with, above (the top wire) or below (the lowest wire) the cables at a distance of 6 m away from them. If a bird was still level with the wires at less than 6 m out then some form of late avoidance action was necessary in order to prevent collision, that is, the bird either climbed over the wires or sometimes flew between them. This variable showed whether birds avoided wires later or took greater risks in windier or wetter weather.

5. Weather estimations: Wind speed (Beaufort estimate) and direction, visibility (metres), percentage cloud cover and rain (1 - barely raining, 2 - light rain, 3 - steady rain, 4 - heavy rain, 5 - storm).

3.3 Ground survey of casualties

The ground beneath power lines 1 and 2 was walked once during each monthly visit in order to look for corpses and casualties which might have struck the power cables. As much of the ground as possible was covered to within 30 m either side of the outside wire using a zig-zag path through the grass or undergrowth. Not all of the ground was either accessible or visible, particularly when work began on the adjacent road construction.

3.4 Presentation of results

The waterbirds observed have been split into four groups for analysis purposes, these are Cormorant, Wildfowl, Gulls and Waders. The species comprising each group are detailed below.

1.CORMORANT: Cormorant (*Phalacrocorax carbo*) and Grey Heron (*Ardea cinerea*).

2.WILDFOWL: Mute Swan (*Cygnus olor*), Shelduck (*Tadorna tadorna*), Wigeon (*Anas penelope*), Mallard (*Anas platyrhynchos*), Pintail (*Anas acuta*), Shoveler (*Anas clypeata*), Pochard (*Aythya ferina*), Tufted Duck (*Aythya fuligula*) and Goldeneye (*Bucephala clangula*).

3.GULLS: Black-headed Gull (*Larus ridibundus*), Common Gull (*Larus canus*), Lesser Black-backed Gull (*Larus fuscus*) and Herring Gull (*Larus argentatus*).

4.WADERS: Oystercatcher (*Haematopus ostralegus*), Lapwing (*Vanellus vanellus*) and Curlew (*Numenius arquata*).

4. RESULTS

4.1 Rate of crossing and monthly distribution of records

On average, more Wildfowl (103 per day) crossed the power lines than any other species group (Fig. 3). Gulls and Waders crossed at the same rate (mean 43 per day) although flock size varied greatly. Gulls tended to cross the power lines singly or in small groups, whereas Waders tended to cross in larger groups, particularly Lapwing (maximum of 120 birds in flock). Herons usually crossed singly whilst Cormorants crossed either singly or in groups (to a maximum of 24 birds per flock).

The peak month of occurrence for Cormorant, Wildfowl and Waders was September whereas peak numbers of Gulls occurred in November and January (Fig. 4 and 5). Throughout the period October to March the number of Cormorants and Herons recorded remained fairly stable. Wildfowl numbers declined after November whilst the number of Gulls recorded each month fluctuated widely. After the peak in September, very few Waders were recorded.

4.2 Direction of crossing power lines and use of wire spans

Cormorants and Herons crossed the power lines in a mainly south-easterly (37.2% of observations) and easterly (25.6%) direction. Wildfowl showed no real preference for a crossing direction as opposed to Gulls which flew in a mainly southerly direction (34.8%). Over 40% of the Waders crossed the power lines in a north-westerly direction (Fig. 6 and 7).

Depending on the purpose and direction of the journey not all birds crossed line 1 and line 2. Of those that did cross line 1 or 2, each bird crossed either span 1, 2 or 3 of line 1 and/or span 4, 5 or 6 of line 2 (Fig. 8). Combining all four species groups we can assess the overall usage of each span within line 1 and 2. Spans 1 and 2 were used at a similar rate (50.5% and 47.2% of crossings respectively) and span 3 was seldom used, only 2.3% of all crossings were made using this stretch. For line 2, 84% of crossings used span 4, whilst spans 5 and 6 were crossed on only 15.6% and 0.4% occasions respectively.

4.3 Crossing height in relation to power line height

There was a difference in the height at which the four groups crossed line 1 (Kruskal-Wallis Test:χ^2 = 17.7, df = 3, p = 0.0005) and line 2 (Kruskal-Wallis Test:χ^2 = 13.1, df = 3, p = 0.0044). The difference may be explained by Cormorants and Herons which tended to cross line 1 and 2 higher than all other species groups (Fig. 9). Wildfowl, Gulls and Waders crossed at a similar but lower height which possibly increased the risk of collision for the species concerned.

Birds approaching the power lines did so at various heights. Their height when 6 m from the cables has been classified into three categories: above (the earth wire), level (between the earth wire and lowest wire) and below (the lowest wire). All four species groups showed a strong tendency to cross both line 1 and 2 above the earth wire (Fig. 10) rather than fly through or below the cables. By combining all four groups we see that 93.5% and 70.5% of birds crossed line 1 and 2 above the earth wire respectively.

Those birds that approach the power lines at a level below the lowest cable tend to pass beneath the power lines and continue on their journey. Of those birds that passed under line 1, Cormorant did with greatest frequency. Gulls most frequently passed under line 2. Waders were not recorded passing under line 1 or line 2 (Fig. 11).

Birds that are level with the power cables at 6 m distance either fly between the cables or take late

avoidance action to prevent collision. Fig. 12 shows that Gulls and Wildfowl are the groups which flew between the cables with greatest frequency, 13.6% of all power line crossings made by Gulls were between the wires. No Cormorants or Herons were recorded flying through the power cables of line 1. Therefore birds tended to pass between the higher, more widely spaced cables of line 1, than they did line 2.

Some birds that passed over, or were forced to take late avoidance action, flew close to the earth wire. Those that crossed at a distance of 1 m or less are termed 'near misses'. At line 1, very few Gulls and Wildfowl were observed to cross this close to the earth wire. At line 2, a higher percentage of Waders (3.8%, n = 340) and Gulls (2.79%, n = 286) were near misses (Fig. 13). However, in general the proportion of birds involved in near misses was very low. Nevertheless, spans 1, 2 and 4 were most often crossed and most of the land below these spans was surveyed.

4.4 Crossing height and climatic factors

There was no significant correlation between wind speed and the height at which all four groups crossed the power lines (Table 1). There was also no significant correlation between visibility and the height at which Wildfowl and Gulls crossed the power lines (Table 1). Sample sizes were too small to perform this analysis for Cormorant and Waders.

4.5 Ground survey of casualties

One Mallard wing was found during the systematic surveys of the ground beneath the power lines. The wing was found on saltmarsh beneath span 4 of the 400 kV power line (line 2).

Systematic searching under line 2 became more difficult and later impossible as the construction of the Deeside link road commenced.

5. DISCUSSION

Field observations resulted in 3,957 individual cases of waterbirds crossing power lines. However, there was only one possible casualty and during the course of the study only one bird was seen to strike the wires.

Wildfowl and Gulls were the most frequently recorded groups of species. Gulls, Wildfowl and Cormorant tended to cross in smaller groups than Waders. September was the peak month for all groups except Gulls.

The lagoons were not the focus of all birds crossing the power lines, 51% of the records involved birds flying straight over the power lines and making no use of the lagoons. These birds flying over (74% of Cormorant, 84% of Gulls) often flew high thus posing little risk of collision. The majority of the records for Wildfowl and Waders however, involved birds flying into and out of the lagoons.

The main directions of travel for each of the four groups was related to their feeding and roosting areas. Cormorants and Herons tended to cross the power lines in a mainly south-easterly and easterly direction, the birds flying from the estuary and adjacent saltmarsh to areas inland. Those Wildfowl and Gulls that flew in a northerly and southerly direction were flying to and from pools and reservoirs to the north and north-east of the National Power plant. Wildfowl and Gulls flying in a south-easterly and north-westerly direction were flying to and from the estuary. Waders flew in a mainly north-westerly direction, flying out towards the estuary and an area of saltmarsh to the north-west of the National Power plant.

Birds tended to cross spans 1 and 2 of line 1 and span 4 of line 2 most frequently. Cormorants and Herons flew higher than the other species groups, this probably explains the significant difference in height at which the four groups crossed the power lines. On the whole, the great majority of birds crossed the power lines above the top earth wire, although some were recorded flying beneath and between the power cables. Gulls were more prone to flying under or between cables than other groups, but gulls are agile species and able to fly between power cables with few problems. Almost all near misses and late avoidances of wires were of the top earth wire (Meyer 1978, James & Haak 1979, Beaulaurier 1981, Faanes 1981).

Waders were more prone to near misses on line 2 than any other species group. Lapwings in particular roosted at the lagoons over night and then flew out towards the estuary the following morning. Thus 62% of the Wader records were of birds flying from the lagoons. On leaving the lagoons they are forced to rise steeply in order to cross the power lines and often appear not to see the cables until late. At this point the tendency was to circle around to gain height before attempting to cross the power lines again often with little space between them and the cable. The highest wire, line 2 seemed to cause greater problems than the closest but lower wire, line 1. However, amongst Waders the proportion of near misses was only 3.8% of total crossings.

Two interesting observations were made of Mute Swans attempting to cross the power lines. In the first instance, three Mute Swans flew in from the estuary heading towards span 4 of line 2. Two of the swans flew under line 1 and 2 and landed on the lagoons whilst the third swan diverted at a late stage and headed back to the estuary. The second observation involved two Mute Swans flying below span 4 and then attempting to fly between the cables of span 2. One swan successfully passed through whilst the second clipped its wing on a cable as it flew through and dropped down. It was found alive on a small ditch covered with bushes beneath the power line. Later in the day the swan had gone so had presumably recovered and moved along the ditch to an area where the ditch widens and take off would be possible. It is well documented (Harrison 1963, Ogilvie 1967, Rose & Baillie 1989) that Mute Swans flying into overhead wires is a prominent reported cause of death. It

is possible that this species is less able than most to negotiate the power lines.

Climatic factors do not appear to increase the risk of collision, increased wind speed did not cause the birds to fly closer to the power lines. There was no evidence for reduced visibility impairing the ability of Wildfowl and Gulls to negotiate the power lines, although throughout the study period visibility was mainly good so there were few opportunities to investigate the effects of reduced visibility on flight behaviour.

The ground survey revealed only one wing of a Mallard beneath a power line. This may have been a casualty or may have been dragged to the area by a predator. The ground surveys gave an accurate representation of casualty rate in the regions that could be surveyed, although some birds may have fallen into the reed bed or areas which could not be checked.

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REFERENCES

Anderson, W.L. 1978. Waterfowl collisions with power lines at a coal-fired power plant. *Wildlife Society Bulletin* 6(2): 77-83.

Beaulaurier, D.L. 1981. *Mitigation of Birds Collisions with Transmission Lines.* Final report for Bonneville Power Administration, Portland, Oregon.

Borell, A.E. 1939. Telegraph wires fatal to Sage Grouse. *Condor* 41(2): 85-86.

Faanes, C.A. 1981. *Assessment of Power Line Siting in Relation to Bird Strikes in the Northern Great Plains.* 1980 Annual Report. U.S. Fish and Wildlife Service, Northern Prairie Wildlife Research Center, Jamestown, North Dakota.

Fielder, G. & Wissner, A. 1980. Freileitungen als tödliche Gefahr für Störche *Ciconia ciconia. Ökologie der Vögel* 2: 59-109.

Harrison, J.G. 1963. Heavy mortality of Mute Swan from electrocution. *Ann. Rep. Wildfowl Trust* 14: 164-165.

Henderson, I.G., Langston, R.H.W. & Clark, N.A. 1995. *A Study of the Risk of Collision with Power Lines by Common Terns at Shotton Steelworks, North Wales.* British Trust for Ornithology Research Report 144, Thetford.

James, B.W. & Haak, B.A. 1979. *Factors Affecting Avian Flight Behaviour and Collision Mortality at Transmission Lines.* Western Interstate Commission for Higher Education-Bonneville Power Administration, Portland, Oregon.

Meyer, J.R. 1978. *Effects of Transmission Lines on Bird Flight Behaviour and Collision Mortality.* Prepared for Bonneville Power Administration, Engineering and Construction Division, Portland, Oregon.

Ogilvie, M.A. 1967. Population changes and mortality of the Mute Swan in Britain. *Wildfowl* 18: 64-73.

Orloff, S., Flannery, A. & Ahlborn, G. 1992. *Wind Turbine Effects on Avian Activity, Habitat Use, and Mortality in Altamont Pass and Solano County Wind Resource Areas - Final Report.* Tiburon, Biosystems Analysis Inc., California.

Rose, P. & Baillie, S. 1989. *The Effects of Collisions with Overhead Lines on British Birds: An Analysis of Ringing Recoveries.* British Trust for Ornithology Research Report 42, Tring.

Scott, R.E., Roberts, L.J. & Cadbury, C.J. 1972. Bird deaths from power lines at Dungeness. *British Birds* 65: 273-286.

Table 1. Spearman correlation coefficients summarizing the relationship between the height at which birds crossed power lines, estimated wind speed (Beaufort scale) and visibility.

	WIND		VISIBILITY	
	Line 1	Line 2	Line 1	Line 2
CORMORANT				
rho	-0.007	0.162		
p	0.968	0.401		
n	36	29		
WILDFOWL				
rho	0.142	0.116	-0.009	-0.039
p	0.002	0.109	0.840	0.587
n	457	192	457	192
GULLS				
rho	-0.045	0.031	0.054	0.114
p	0.341	0.716	0.247	0.185
n	458	137	458	137
WADERS				
rho	-0.162	-0.135		
p	0.377	0.606		
n	32	17		