British Trust for Ornithology

BTO Research Report No. 215

A study of the risk of collision with power lines by waterbirds at Shotton Steel Works, North Wales

Authors

D.E. Balmer & S.J. Holloway

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A report by the British Trust for Ornithology to Manweb

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To Manweb

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1. EXECUTIVE SUMMARY

1. A report by Balmer *et al.* (1995) investigated the impact of power lines at Shotton Steel Works, North Wales on waterbirds wintering on the lagoons and on birds crossing the power lines to reach nearby habitats. The aim of this report was to re-assess the risk of collision with power lines by waterbirds.

2. Field observations were made of all waterbirds attempting to cross the 132kV power line (line 1). Their direction and height of flight, together with weather variables were recorded. Systematic surveys were also made of the ground beneath the power lines in order to look for casualties.

3. In total, 380 observations were made of birds crossing the line 1, accounting for 924 individual birds. Gulls and Waders were the most frequently recorded groups of species. The peak month of crossings for Wildfowl, Gulls and Waders was October, whereas Cormorants peaked in November. Cormorants, Wildfowl and Gulls tended to cross in smaller groups than Waders. Almost three-quarters of the observations involved birds flying straight over line 1 and making no use of the lagoons.

4. The main directions of travel were largely a reflection of the birds' feeding and roosting habits. Cormorants and Waders tended to journey between the estuary and inland areas, whereas Wildfowl and Gulls also travelled between the pools and reservoirs to the north and the lagoons. The span to the north of the lagoons was crossed most frequently.

5. The majority of birds of all four species groups crossed line 1 above the top earth wire, and only a small proportion were recorded flying either beneath or through the power cables. Only 0.5% of birds came within 1 m of the top earth wire.

6. A significant negative correlation was found between wind speed and the height at which Gulls crossed line 1. The height at which Wildfowl crossed line 1 was found to be positively correlated with visibility.

7. No waterbirds were seen to hit the power lines and no casualties were found beneath the power lines during the extensive ground search. In general, mortality rate of waterbirds due to collisions with wires was considered to be very low.

8. Comparison with Balmer *et al.* (1995) showed many similarities, particularly in terms of the species recorded crossing the power line and the main directions of travel. In both studies the majority of birds were observed flying straight over the power lines and making no use of the lagoons. In contrast, on average fewer birds were recorded crossing the power lines per day in the 1998 study than in the previous study in 1995.

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

10. Observations suggest that if the proposed new 132kV power line is erected, waterbirds crossing the power lines or making use of the lagoons in the vicinity of the power lines during the autumn/winter period are unlikely to be affected.

2. INTRODUCTION

The aim of this study was to update the previous study by Balmer *et al.* (1995) on the potential impact of power lines on local waterbird populations at Deeside Industrial Park. Reports by Henderson *et al.* (1994) and Balmer (1998) investigated the risk of collision with power lines by Common Terns *Sterna hirundo*.

The threat that power lines may pose to birds has been well documented (Borell 1939, Walkinshaw 1956, Scott *et al.* 1972). Birds have been at risk 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).

Manweb is proposing to construct a new 132kV power line within the Deeside Industrial Park parallel to an existing 132kV power line (line 1 on Fig 1.). The new power line will be located just to the south of line 1 and closer to the ornithological interest. In this study, fieldwork concentrated only on the existing 132kV power line and not the 400kV line as well (*cf* Balmer *et al.* 1995).

3. METHODS

3.1 Study Site

The water-filled lagoons are situated within the industrial complex of Shotton Steelworks, on Deeside, North Wales (OS 296 707). Observations were made in the vicinity of the lagoons where the Common Tern colony is situated during the summer months. Surrounding the lagoons is wasteland which gives way to saltmarsh to the north and west (Fig 1.). The new Deeside link road (A548) crosses the saltmarsh to the north-west of the lagoons and provides a further potential obstacle for birds commuting between the lagoons and estuary.

Waterbirds flying to and from the estuary need to cross the suspension bridge road and the power lines. 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 commuting 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 5km to the north-west of the lagoons.

The nearest power line to the lagoons (line 1) is approximately 100 m from the lagoons at its closest point. Line 1 carries 132kV 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 group of cables are 2.8 m apart Line 1 consists of wire spans 0, 1 and 2 as illustrated on Fig 1.

The 400kV power line is a relatively new construction 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 wire) with the 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. In the present study, observations of waterbirds crossing this line were not recorded.

3.2 Data collection

Systematic observations were made of all waterbirds attempting to cross line 1 on four days during each of the months of September, October and November. On most days counts were made from dawn until dusk. In Balmer *et al.* (1995) observations were made over seven months (September to March).

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

1. Direction of journey.

2. Whether the bird flew into the lagoons, out of the lagoons or flew over the power lines whilst moving between two points.

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

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

5. Whether the bird approached a group of power lines either level with, above (the top earth 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 climbed over the wires or sometimes flew between them. This variable showed whether birds avoided wires late or took greater risks in windier or wetter conditions.

6. 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 line 1 was walked once during each monthly visit in order to look for corpses and casualties which might have struck the power cable. 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.

3.4 Presentation of results

The waterbirds 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: Teal (*Anas crecca*), Mallard (*Anas platyrhynchos*), Shoveler (*Anas clypeata*) and Tufted Duck (*Aythya fuligula*).

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 Waders (41 per day) crossed line 1 than any other species (Fig 3.). Wildfowl and Gulls crossed at a similar rate (30 and 29 per day respectively). Gulls tended to cross line 1 singly or in small groups, whereas Waders tended to cross in larger groups. Two large flocks of Lapwing, one of 40 and one of 160 heavily influenced these results. Wildfowl mainly cross in small groups, the largest flock recorded was of 15 Mallard. Herons usually crossed singly whilst Cormorants crossed either singly or in groups of up to 10 birds.

Compared with the results from the winter 1994/95 work (Balmer *et al.* 1995), on average, fewer birds were recorded crossing the power lines. In particular, Wildfowl numbers are considerably reduced - an average of 103 per day were recorded in the previous study. Results for Cormorant are very similar.

October was the peak month of occurrence for Wildfowl, Gulls and Waders whereas peak numbers of Cormorants occurred in November (Fig 4.). Throughout the period September to November the number of Cormorants and Gulls recorded remained fairly stable. The occurrence of Waders was sporadic during the study period, no Waders occurred in November. Wildfowl numbers fluctuated widely.

4.2 Direction of crossing power lines and use of wire spans

As in the previous study Balmer *et al.* (1995) Cormorants and Herons crossed line 1 in a mainly south-easterly (51.9% of observations), although the north-westerly (29.6%) direction was important in 1998 (Fig 5.). Wildfowl crossed in a northerly and southerly direction in similar numbers (33.3% and 31.5% respectively). Gulls crossed the power lines in all directions, but were observed crossing in a mainly south-easterly (25.8%), southerly (24.2%) and northerly (22.5%) direction. Eighty percent of Waders crossed line 1 in a north-westerly direction (Fig 6.), the direction also favoured in the previous study.

Birds crossing the power lines are either flying into the lagoons from the estuary or nearby lagoons, flying out of the lagoons to surrounding habitats or flying over the power lines *en route*. Cormorants (85.2%), Gulls (97.9%) and Waders (80.0%) were mainly recorded flying over the power lines rather than using the lagoons themselves. Similar numbers of Wildfowl were recorded flying into the lagoons (49.1%) and out of the lagoons (37.0%), only a small percentage were observed over-flying the area (Fig 7.).

Of the waterbirds observed crossing line 1, each bird crossed either span 0, 1 or 2 (Fig 1.). Cormorants and Herons crossed spans 2 (44.4%) and 1 (37.9%) in similar proportions. The majority of Wildfowl crossed span 0 (65.7%) and Waders crossed span 1 (80.0%). Gulls mainly crossed spans 0 (41.7%) and 1 (34.6%). Over all birds, 46.3% of observed crossings were over span 0 compared with 34.5% over span 1 and only 19.2% over span 2 (Fig 8.).

4.3 Crossing height

There was a significant difference in the height a which the four groups crossed line 1 (Kruskal-Wallis Test:χ^2 = 21.7, df = 3, p = 0.0001). The difference may be explained by Waders which tended to cross line 1 higher (average 32.5 m) than all the other species groups and for which the sample size was small (Fig 9.). Cormorants and Herons crossed line 1 at an average height of 23.9 m. Wildfowl and Gulls crossed at a similar but lower height. In the previous study, Cormorants and Herons tended to cross line 1 higher than all the other species groups.

The height at which birds approached the power lines varied. 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 tended to approach line 1 above the earth wire (Fig 10.) rather than level or below the cables. By combining all four species groups we see that 93.7% of birds crossed line 1 above the earth wire. This is similar to the 93.5% recorded in the previous study (Balmer *et al.* 1995).

Birds approaching line 1 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 (2%). Less than 1% of Gulls and Waders crossed line 1 under the lowest power cable. No Wildfowl were recorded in this category (Fig 11.).

Those 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. Less than 1% of Gulls were recorded flying between the cables. No Cormorants, Wildfowl or Waders were observed flying through the power cables of line 1 (Fig 11.).

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'. Almost 2% (n= 324) of Wildfowl were observed to cross this close to the earth wire, and 0.28% (n= 347) of Gulls (Fig 12.). There were no 'near misses' involving Cormorants and Waders. In general, the proportion of birds involved in 'near misses' was very low.

4.4 Crossing height and climatic factors

There was a statistically significant negative correlation between wind speed and the height at which Gulls crossed over line 1 (rho = -0.186, n = 234, p = 0.004). There was no significant correlation between wind speed and the height at which Cormorant, Wildfowl and Waders crossed (Table 1.). There was also a weak statistically significant positive correlation between visibility and the height at which Wildfowl crossed line 1 (rho = 0.200, n = 108, p = 0.038). No significant correlation between rain and the height at which all four species groups crossed line 1 was found. Sample sizes were to small to perform some of these analyses for Waders.

4.5 Ground survey of casualties

No corpses of waterbirds were found during the systematic surveys of the ground beneath the power lines.

5. DISCUSSION

Thirteen species of waterbird was recorded crossing the 132kV power line (line 1) during the study period September 1998 to November 1998. Birds were recorded throughout the day, but particularly during the early morning and late afternoon.

A total of 380 crossings were recorded during field observations, resulting in 924 individual waterbirds crossing line 1. No corpses were found during the systematic search and no birds were seen to strike the wires.

Gulls and Waders were the most frequently recorded species. Cormorants, Gulls and Wildfowl tended to cross in smaller groups than Waders. October was the peak month for Wildfowl, Gulls and Waders. The peak month for Cormorants was November.

Not all waterbirds crossing the power lines make use of the lagoons, 73% of the records involved birds flying over line 1 whilst journeying to surrounding habitats. Cormorants (85.2%), Gulls (97.9%) and Waders (80%) tended to fly over the power lines without making use of the lagoons. They tended to fly high thus posing little risk of collision. The majority of observations of Wildfowl concerned birds flying in 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 in a mainly south-easterly and north-westerly direction, the birds flying from the estuary and adjacent saltmarsh to inland areas and back again. Wildfowl that crossed line 1 mainly 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. Gulls also followed this pattern, but in addition crossed in a south-easterly direction with some frequency, on their way to feeding grounds on the estuary. Waders flew in an mainly north-westerly direction, flying out towards the estuary and adjacent saltmarsh to the north-west of the National Power plant.

The frequency with which birds crossed spans 0 to 2 reflects the direction of travel of the different species groups. Span 0 was crossed with greatest frequency, 46.3% of all crossings were over this span and was used mainly by birds journeying in a north-south direction (predominately wildfowl). Span 1 accounted for 34.5% of all crossings over line 1 and was used largely by species travelling to and from the estuary. Only 19.2% of crossings were made over span 2 and involved birds journeying between the estuary and areas inland.

Waders tended to cross line 1 at a greater height than the other species group. Cormorants and Herons also flew relatively high. The majority of birds approached line 1 above the earth wire (93.7), very few approached below or level with the power cables. Only Gulls were recorded passing between the cables, but gulls are agile species and able to fly between power cables with few problems.

Almost all near misses and late avoidances of wires involved the top earth wire (Meyer 1978, James & Haak 1979, Beaulaurier 1981, Faanes 1981). Wildfowl were more prone to 'near misses' than any other species group. Wildfowl departing the lagoons to commute to nearby pools and reservoirs are forced to rise steeply in order to cross line 1 and do not see the power

lines until late. Wildfowl were observed to divert at a late moment and to circle around to gain height before successfully crossing the power lines. For all species groups combined, the proportion of crossings which were considered to be 'near misses' was only 0.5%.

The negative correlation coefficient between wind speed and the height at which Gulls crossed line 1 means that as the wind speed increases Gulls fly closer to the top earth wire. As mentioned before, Gulls are agile species and are likely to be capable of taking late avoidance action if necessary. The weak positive correlation between visibility and the height at which Wildfowl cross the top earth wire. This suggests that in times of reduced visibility, Wildfowl fly closer to the top earth wire and are at greater risk of collision.

The survey of the ground beneath the power lines did not reveal any corpses. 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. In conclusion, the mortality rate of waterbirds due to collisions with wires was considered to be very low at this time of year.

Wildfowl are the only species group to make notable use of the lagoons, 86% of the observed crossings involved Wildfowl flying into or out of the lagoons. However, all Wildfowl crossed over the top earth wire and there were no instances of Wildfowl passing through or under the spans. Two percent however, flew close (within 1 m) to the top earth wire and so risked collision. The proposed 132kV power line may have some adverse effect on this species group as it will be closer to the lagoons than the existing line 1.

Given that over 90% of the crossings of line 1 (by all birds) were made above the top earth wire and that 80% or more of the Cormorants, Gulls and Waders fly straight over line 1 without making use of the lagoons, the likely implications of the proposed 132kV power line on waterbirds at this time of year are considered to be negligible.

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

	WIND	VISIBILITY	RAIN
CORMORANT			
rho	-0.081	0.156	0.286
p	0.693	0.447	0.157
n	26	26	26
WILDFOWL			
rho	0.051	0.200	-0.088
p	0.598	0.038	0.364
n	108	108	108
GULLS			
rho	-0.186	-0.103	-0.066
p	0.004	0.116	0.318
n	234	234	234
WADERS			
rho	-0.544		
p	0.456		
n	4		

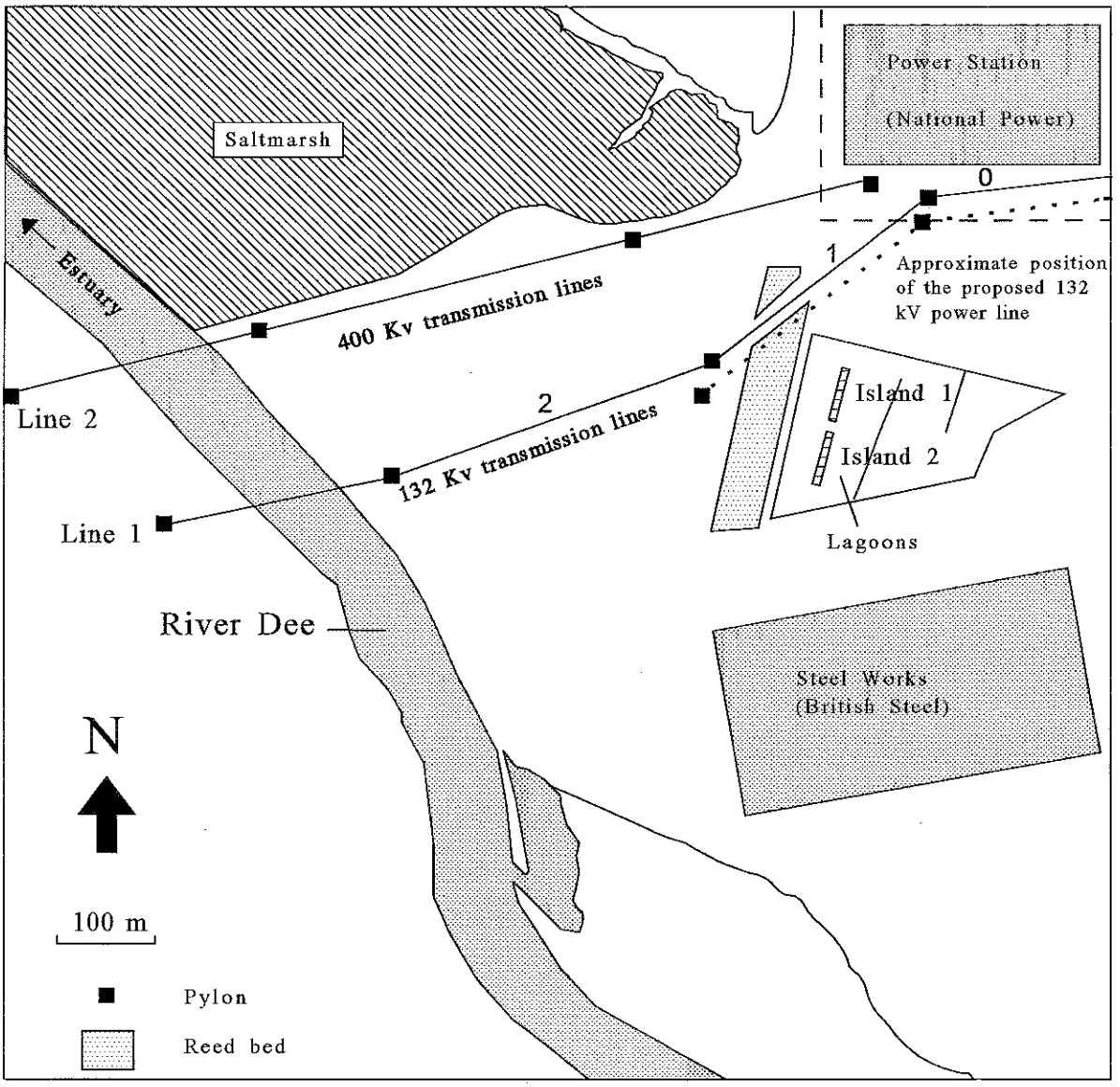

Fig.1 The study area and the position of the lagoons in relation to the power lines, industrial complex and estuary. On line 1 the figures 0 to 2 refer to wire spans.

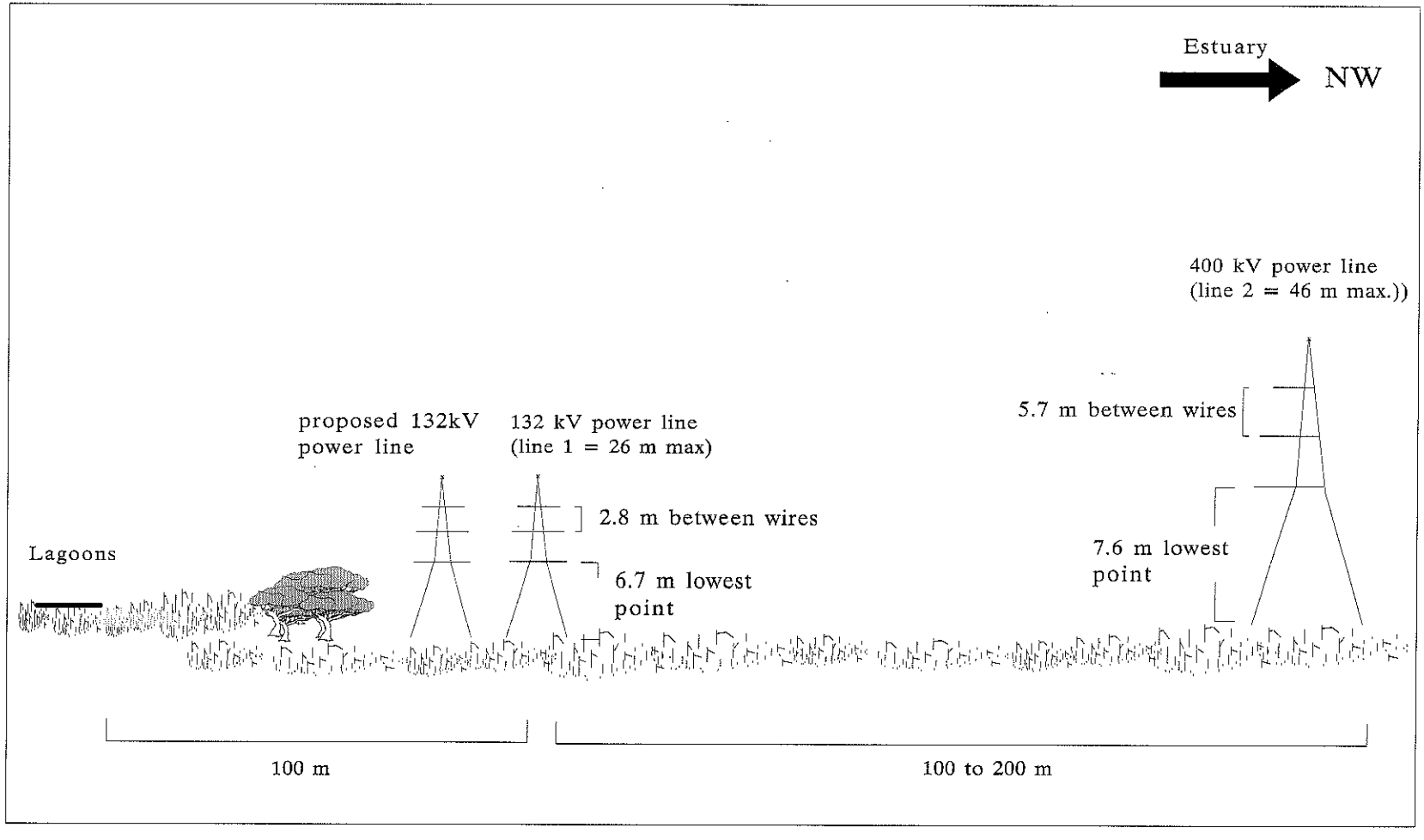

Fig. 2 A profile view of the position and height of the pylons in relation to the freshwater lagoons.

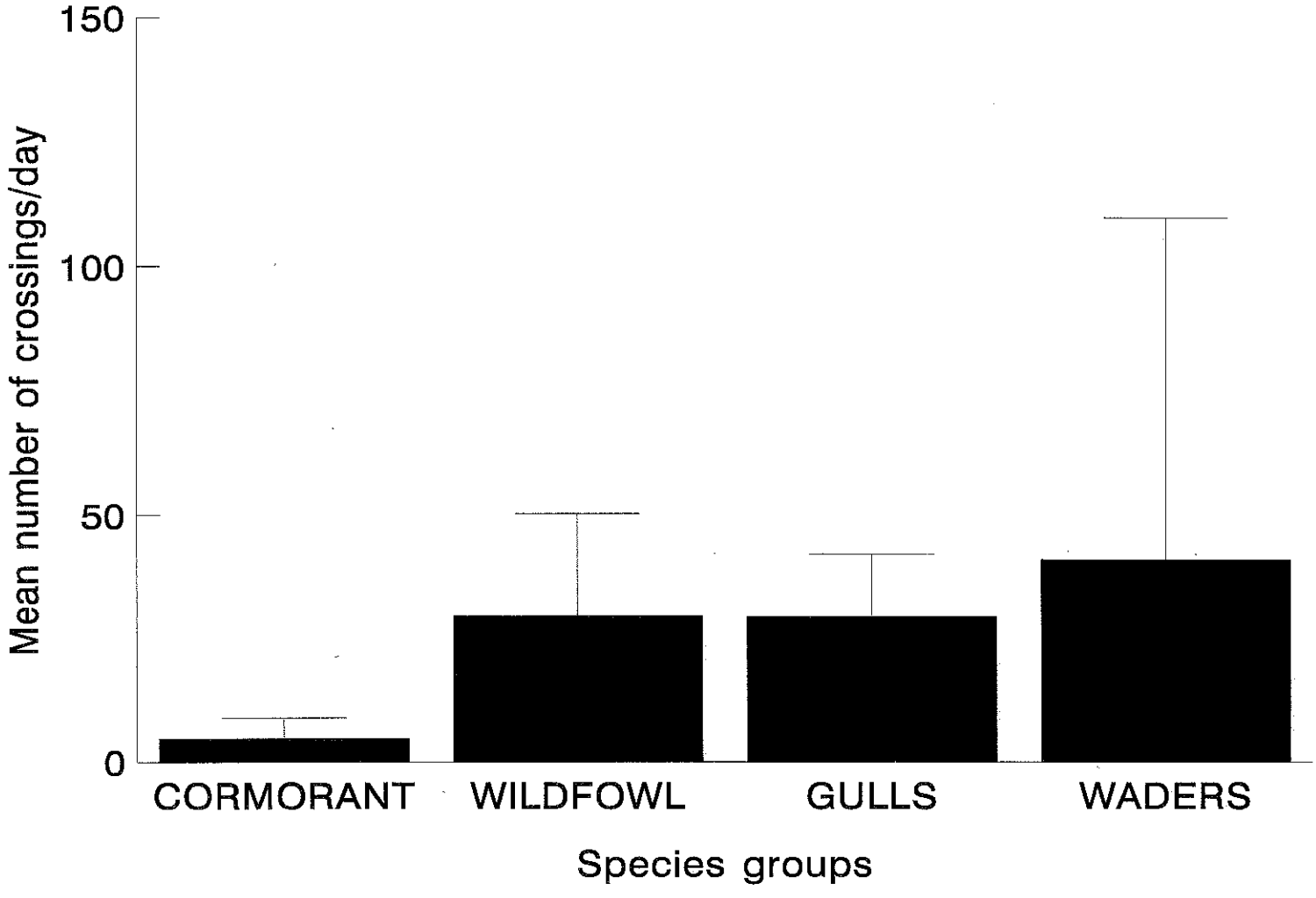

Fig.3 Mean number of bird crossings per day

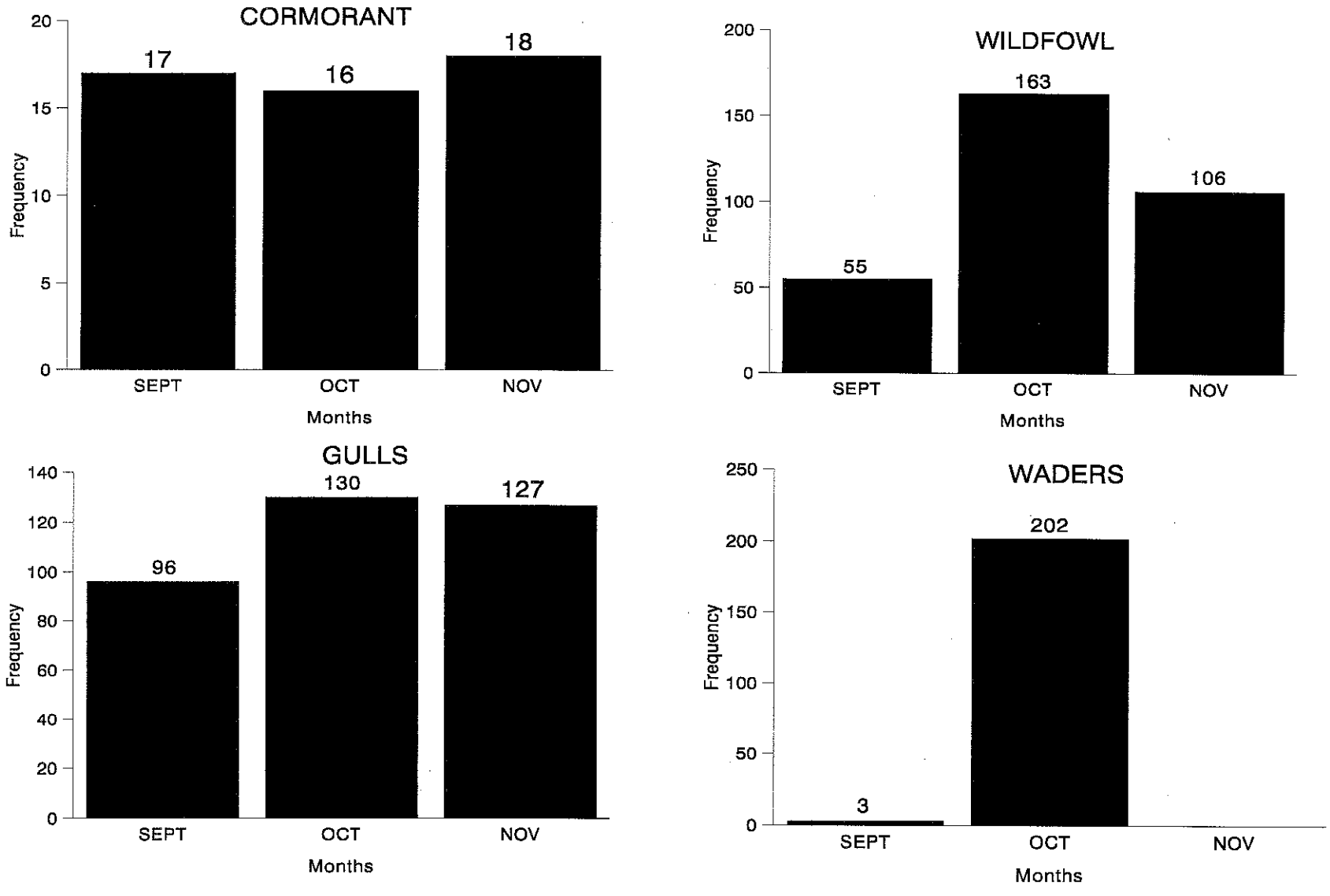

Fig.4 The frequency of birds each month crossing line 1

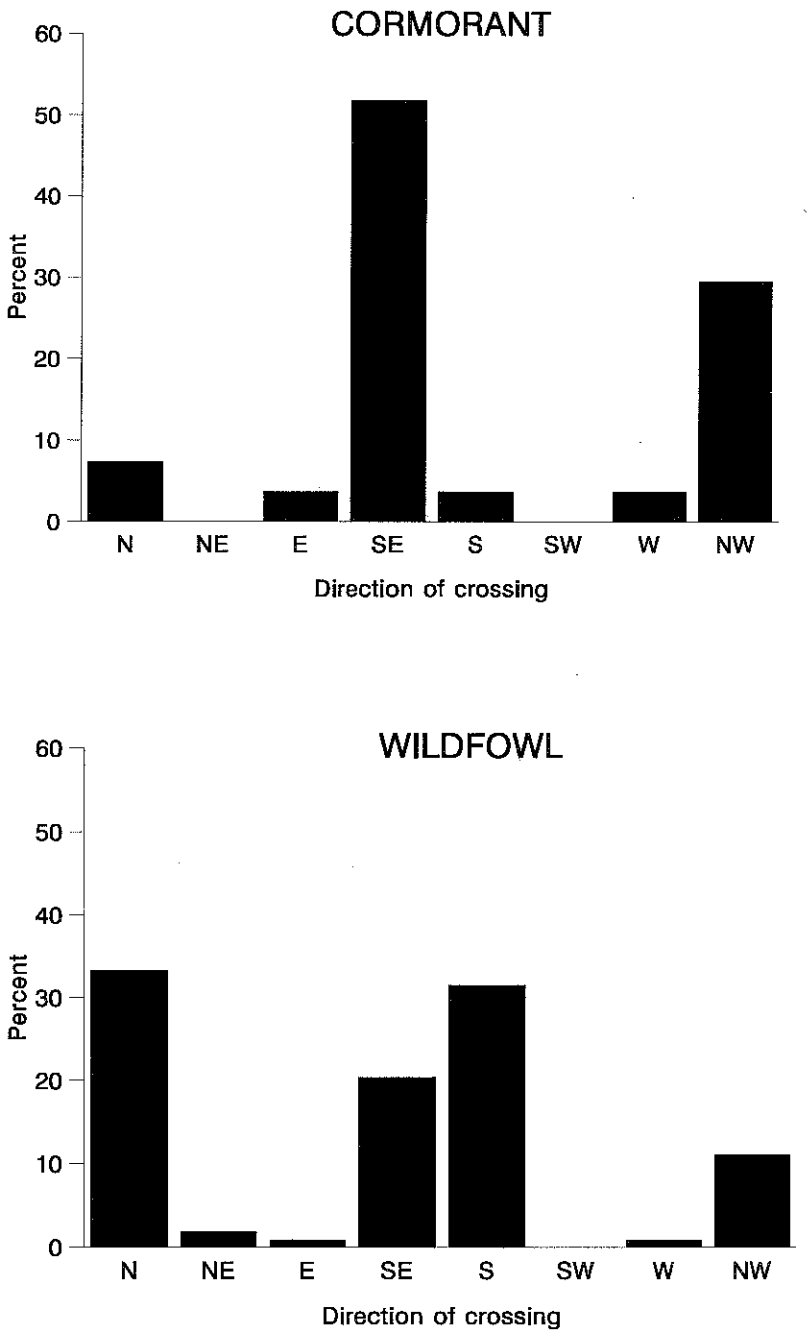

Fig.5 The percentage of Cormorant and Wildfowl crossing the lines in particular directions

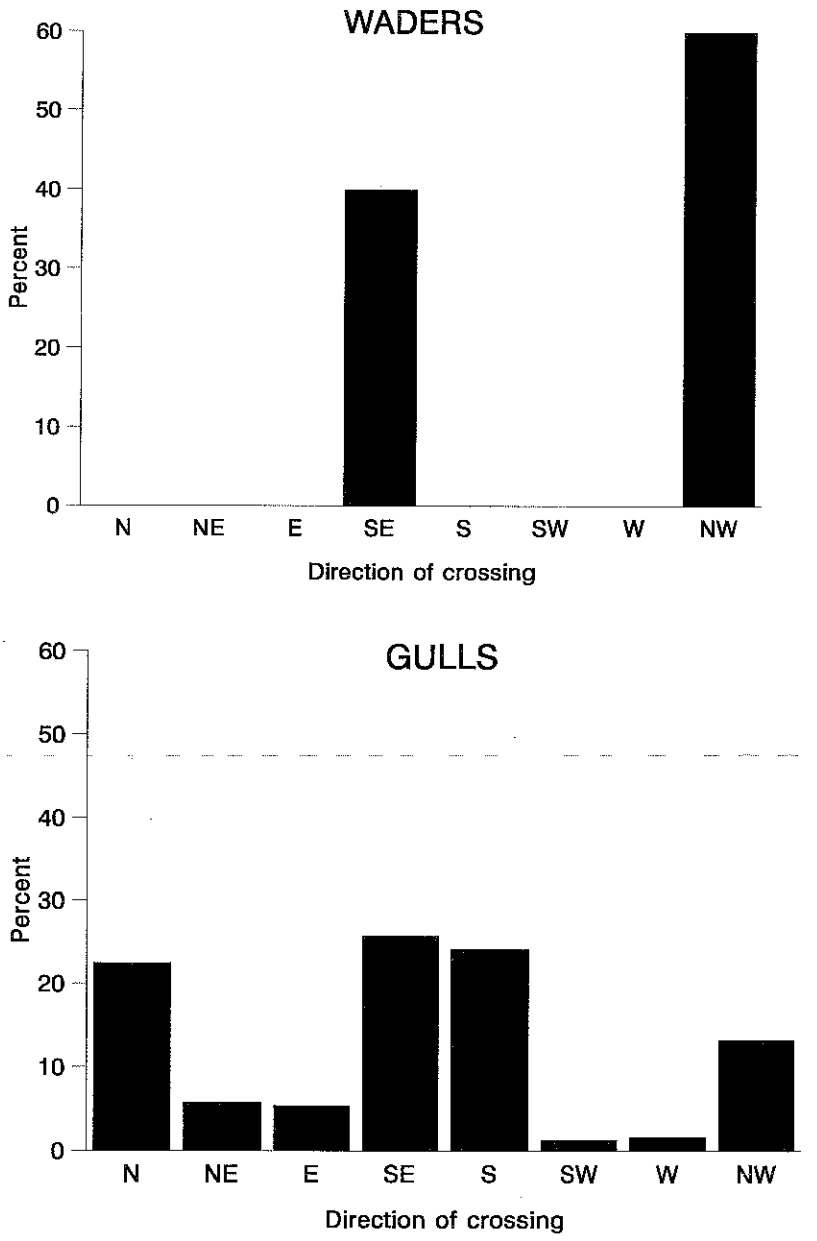

Fig.6 The percentage of Waders and Gulls crossing the powerlines in different directions

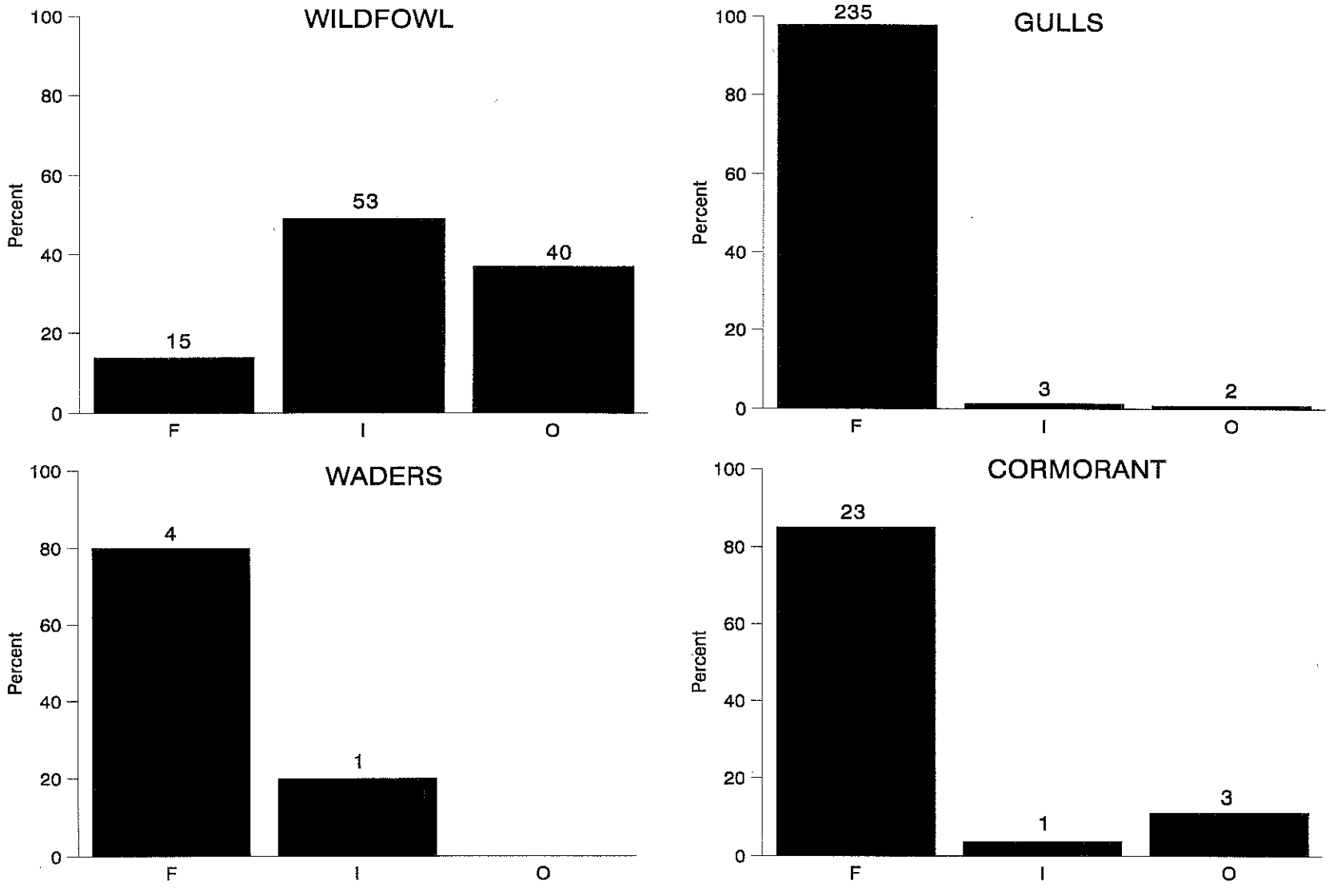

Fig.7 The percentage of birds flying over (F) the lines, flying in (I) to the lagoons and out (O) of the lagoons. Numbers above the bars indicate sample sizes.

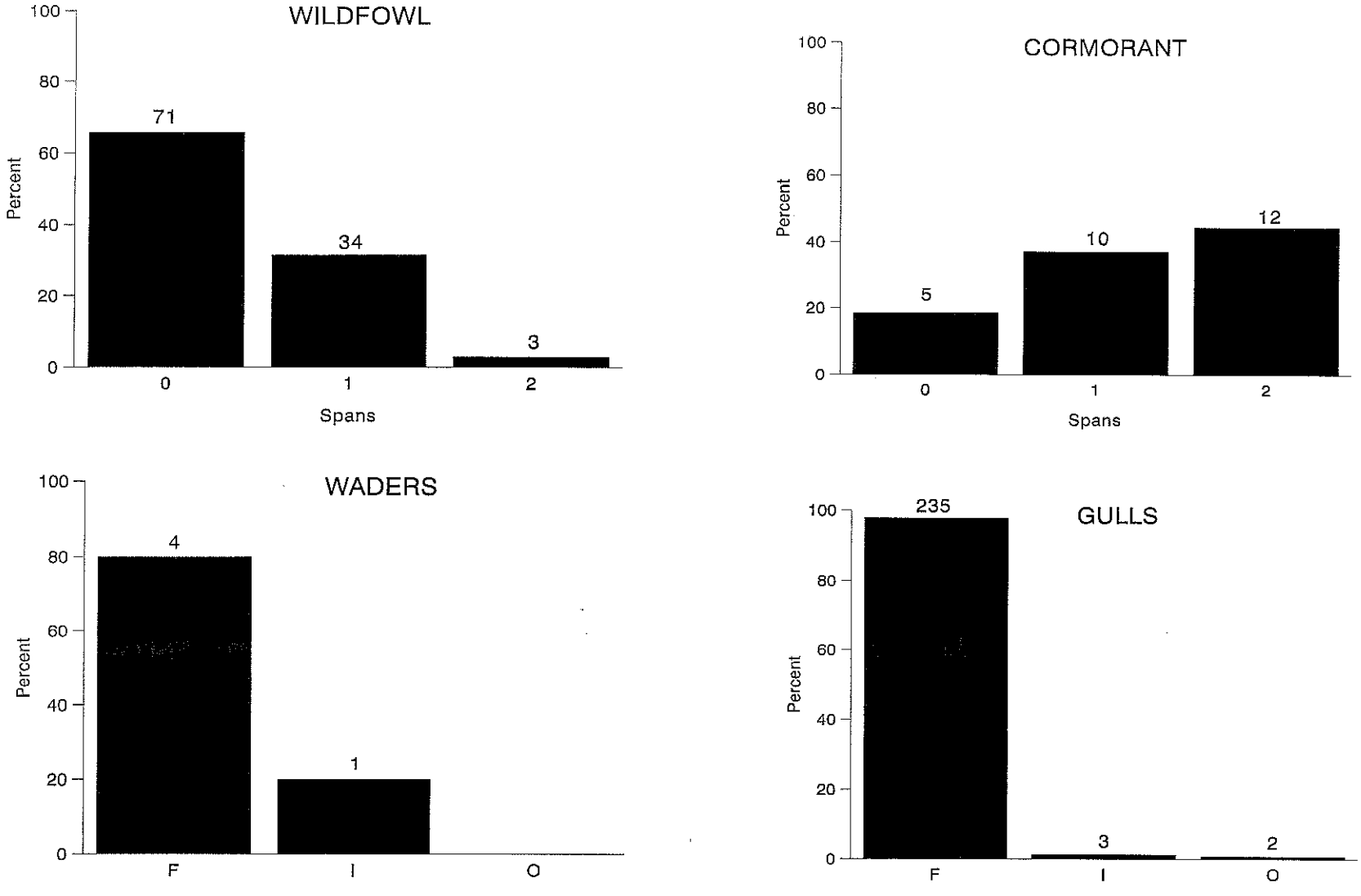

Fig.8 The percentage of birds crossing spans 0-2 on line 1. Numbers above the bars indicate sample size.

Fig.9 Mean height (m) of birds crossing the highest point of line 1

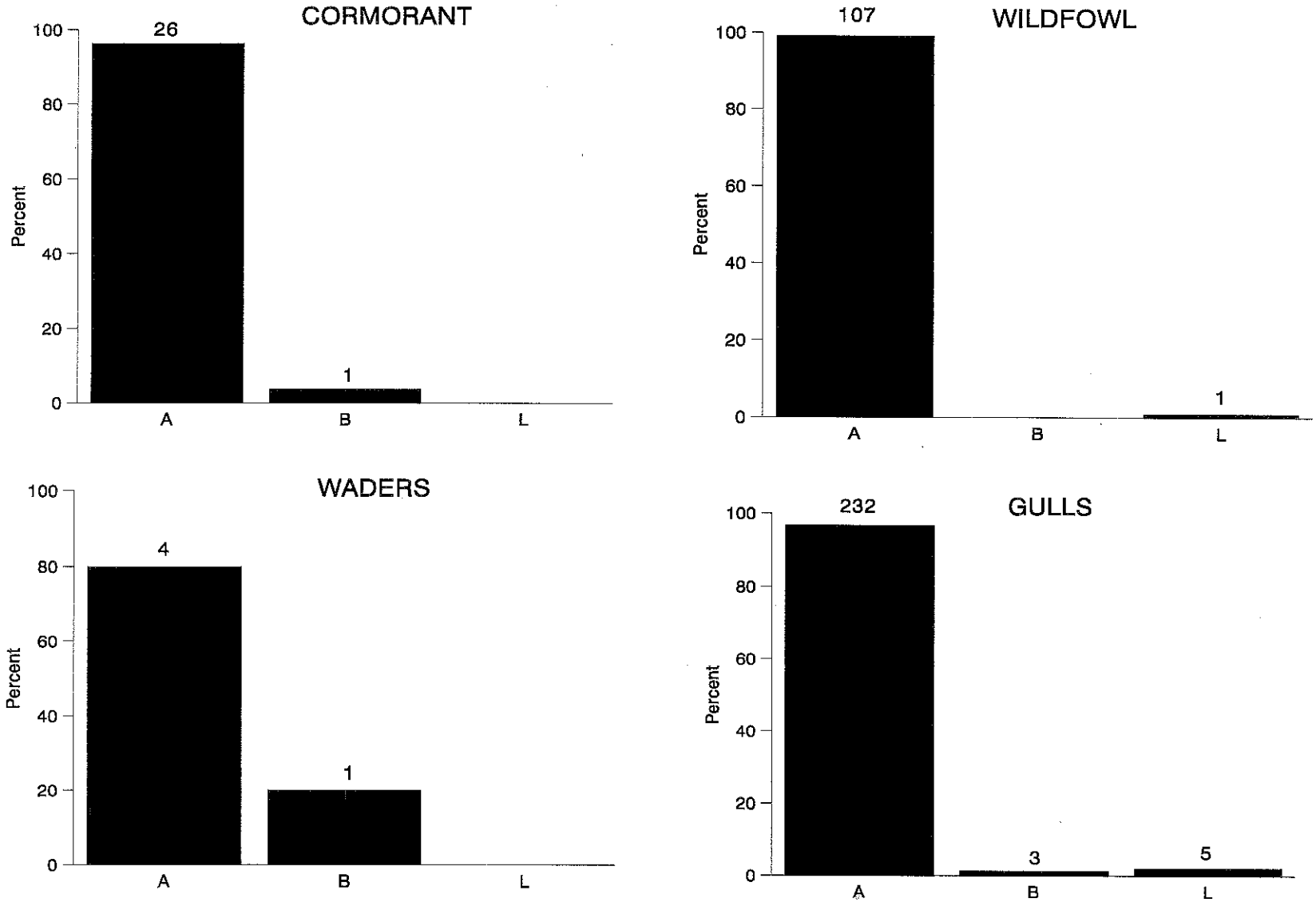

Fig.10 The percentage of birds approaching above the earth wire (A), level with the wires (L) and below the lowest wire (B) when at 6m distance. Numbers above the bars indicate sample sizes.

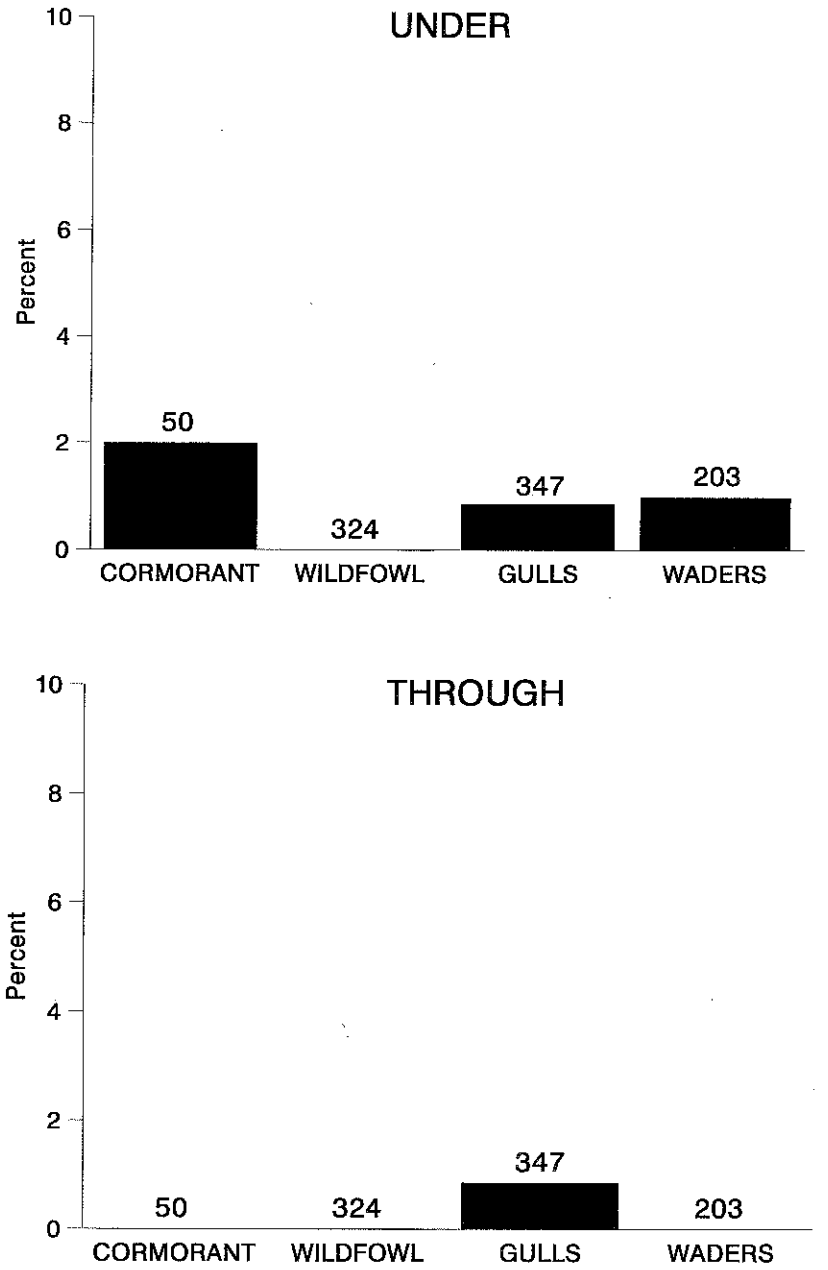

Fig.11 The percentage of birds passing under the lowest cable or flying through the power cables of line 1. Numbers above the bars indicate sample sizes.

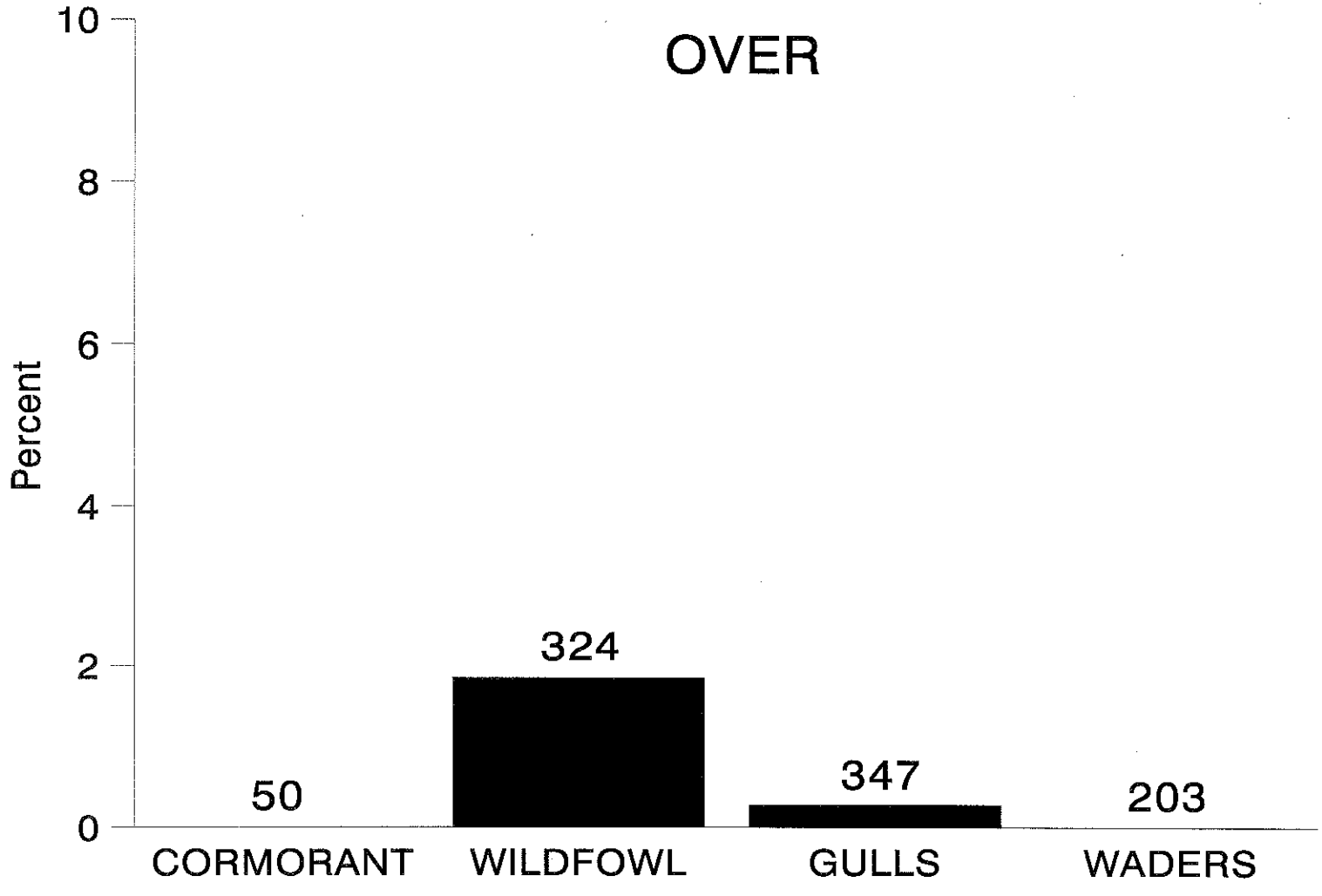

Fig.12 The percentage of birds crossing the top earth wire of line 1 at a distance of 1m or less (near miss). Numbers above the bars indicate sample size.