natural
RESEARCH LTD

NATURAL RESEARCH INFORMATION NOTE 3

DERIVING COLLISION AVOIDANCE RATES FOR RED KITES *MILVUS MILVUS*

D.P. Whitfield & M. Madders

AUGUST 2006

Banchory Business Centre, Burn O'Bennie Road, Banchory, Aberdeenshire, AB31 5ZU
T: +44 (0)1330 826 536. F: +44 (0)1330 820 670

The preferred citation of this document is:

Whitfield, D.P. & Madders, M. 2006. Deriving collision avoidance rates for red kites *Milvus milvus*. Natural Research Information Note 3. Natural Research Ltd, Banchory, UK.

Natural Research Information Notes are available to download from the Natural Research website: www.natural-research.org

ABSTRACT

Several ‘Band’ Collision Risk Model (CRM) avoidance rate estimates have been derived for several birds of prey, but none are available for red kites due to a lack of appropriate available data. In the absence of any means to use an empirically derived avoidance rate, two options are available in practice: use a generic 95% ‘precautionary’ rate or use a rate based on empirically derived measures in other birds of prey. A generic ‘precautionary’ Band CRM avoidance rate of 95%, proposed before any empirical measures were derived, is increasingly being revealed to produce unrealistic predictions of collision fatality rates. Given a similarity between many recently derived estimates of CRM collision avoidance rates in birds of prey, a more reasonable approach to derive a likely avoidance rate in a bird of prey such as the red kite where there is no empirically based estimate is to assume that it too will be similar. This assumption should preferably be qualified if possible, however, by an assessment of whether kites are more or less likely to die through collision than other species.

Most estimates of avoidance rates for birds of prey lie between 98% and 100%. At least at some sites avoidance rates are not 100% in red kites and so an initial assumption was made that red kites would show an avoidance rate of above or equal to 98% but below 100%. This assumption was checked using data for several birds of prey collected at 13 wind farms in northern Spain by Lekuona & Ursúa (2006). These data indicated that red kites (and black kites) were not relatively vulnerable to collision strikes compared with other birds of prey. (Griffin vultures and common kestrels appeared to be relatively vulnerable to collision strikes.) Thus, the initial assumption was not contradicted, so it was concluded that an appropriate avoidance rate for red kites should probably be over 98%; likely around 99%. Clearly, however, empirically derived measures should be sought through work at operational wind farms.

INTRODUCTION

The 'Band' Collision Risk Model (CRM) attempts to predict the collision fatalities at a wind farm on the basis of physical properties of turbine rotor blades and the activity of birds within a rotor swept volume which brings them at risk of collision (Band et al. 2006). Model outputs assume that birds take no avoidance action but, because in practice birds mostly take action to avoid collision, a correction factor or 'avoidance rate' must be applied to the model output so as to resemble reality. In the absence of any estimates of avoidance rates at the time of the Band CRM development a 'precautionary' estimate of 95% was assumed (i.e. 95% of all flights which should lead to a strike would not result in a strike), based on a best guess. A major criticism of the Band CRM (and indeed all CRMs in practical use: Madders & Whitfield 2005) is that the value of the avoidance rate has a strong influence on predicted deaths yet there is little empirical basis for rate estimation, leading to a call for abandonment of the CRM until more empirical support is available (Chamberlain et al. 2005, 2006). Recently, however, some preliminary estimates of avoidance rates in some raptors (Whitfield & Madders 2006, Whitfield & Band in prep.) and geese (Fernley et al. 2006) have been derived using data from USA wind farms.

Avoidance rates have not been estimated for the red kite *Milvus milvus* due to a lack of available data.[1] This leaves open two options if such rates are required to assess wind farm proposals: resort to a 'precautionary' value of 95%, or use information from related species to derive a more educated guess. There are several difficulties with adopting a 'precautionary' value of 95%: the value has no foundation in any citable studies and increasingly it is being revealed to produce unrealistic predictions in many situations. In the absence of any empirical measures at the time of its proposal it seemed to be a reasonable guess, but once empirical evidence becomes available, this generic 'guess' should be revised to reflect the evidence in order to retain some confidence in the utility of the Band CRM. It is of interest and relevance, therefore, to note that an independently derived CRM, by Biosis in Australia has seen fit to revise generic avoidance rates upwards as empirical evidence has accumulated (Smales 2005, 2006).

[1] Uncertainty over carcass search corrections and flight activity at RSH in Lekuona & Ursúa (2006) introduces uncertainty over derived avoidance rates. Using what may be reasonable assumptions, it seems likely that avoidance rate was ≥ 99% using methods described by Whitfield & Madders (2006), but this must be viewed very cautiously given caveats over the assumptions.

A more reasonable and justifiable approach is to base an avoidance rate estimate for red kites on findings from other similar species, preferably also using secondary data for an additional check for any indications that red kites may be unusually prone to collision: any deviations which may indicate that kites may not be similar would reduce confidence in the basic approach of assumed similarity. Hence, the estimation (or, more realistically, educated guess) process has two stages:

1. Examine the evidence of avoidance rates in other raptors to develop a reasonable estimate through assumed similarity;
2. Examine additional evidence to check if red kites may or may not be unusually prone to collision as a verification process for stage 1.

AVOIDANCE RATES IN RAPTORS

Although there are apparently no accessible data currently amenable to estimating an avoidance rate in red kites, it is probably safe to assume that at least at some sites it is less than 100%. For example, despite no kite casualties having been found at a wind farm site in Wales during a post-construction study (Percival 2000), casually discovered victims have been found at Welsh wind farms, and casualties have also been documented at Swedish, German and Spanish wind farms (Dürr 2004, Lekuona & Ursúa 2006).

In other diurnal raptor species preliminary estimates of avoidance rates at USA wind farms were typically 98% - 100% (Whitfield & Madders 2006, Whitfield & Band in preparation) (Table 1). Note that several of these estimates were derived from the Altamont Pass Wind Resource Area (APWRA) in California and are probably underestimates (i.e. avoidance rates should be higher) because they were generated from generic observations conducted within APWRA and more detailed observations have shown that, for example, in golden eagles *Aquila chrysaetos* and red-tailed hawks *Buteo jamaicensis* flight activity was significantly greater in the airspace close to turbine rotor blades (Smallwood & Thelander 2004, 2005). This greater propensity to fly near turbines was apparently often related to a greater abundance of prey in these areas, which in turn appeared to be due to post-construction management e.g. cattle grazing and turbine construction methods such as the creation of rock piles around turbine bases (Smallwood & Thelander 2004, 2005, Thelander & Smallwood 2006)[2]. Hence, the risk of collision will have been higher than indicated by 'average' flight activity across generic observation plots and so preliminary avoidance rates estimated by Whitfield & Band (in preparation) from such average activity estimates will have been too low.

It would be reasonable to conclude tentatively from these results, nevertheless, that an average avoidance rate in red kites is liable to be similar to these other species (especially to the most similar species, the red-tailed hawk) and so will probably be ≥ 98% but < 100%. This conclusion may not be reasonable however, if red kites are for some unknown reason unusually prone to collision.

ARE KITES PRONE TO COLLISION?

One method which can be used to assess the relative vulnerability of red kites is to examine, given relative species differences in behaviour which may increase collision risk, whether kites are more or less likely to die through collision. This requires comparable data on flight activity and collision fatalities across several bird of prey species; one of the most complete datasets in this respect has been gathered at several wind farms in Navarra, northern Spain (Lekuona & Ursúa 2006) (Table 2).

Searches for collision victims at wind farms can be biased for at least three reasons: carcasses are not found by observers within the search area, carcasses are removed before they can be found by observers e.g. scavenging, and birds are fatally wounded within the search area but die outside it (Gauthreaux 1995). Most research attention has focussed on the first two biases and indicates that large birds are most likely to be found by observers and least likely to be removed before they can be detected by searches (e.g. Erickson 2003). The study of Lekuona & Ursúa (2006) did not completely account for (or report) carcass search biases; however it is safe to assume that, as a relatively large bird of prey species, red kites will not have been especially prone to fatality underestimation. Consequently 'raw' counts of fatalities should not be unduly influenced

[2] These results, incidentally, indicate greater attention should be paid during impact assessments to any habitat modifications around turbines due to their construction which may elevate prey abundance/availability.

relative to other bird of prey species in favour of finding lower counts because of biased carcass search methods.

Using Lekuona & Ursúa's (2006) results (Table 2), a simple plot of number of birds seen against number of dead birds found (as the response variable) did not suggest that red kites were more likely to be found dead based on their relative abundance (Fig. 1). Simple counts of number of birds seen in or over the wind farm area, however, may not necessarily reflect risk of collision (e.g. birds may have flown higher than the upper limit of the rotor sweep). A better metric of relative collision risk was presented by Lekuona & Ursúa (2006) in the form of counts of the number of birds seen to fly close to rotor blades (Table 2) and a log-log plot of this against fatalities therefore provided a better method (Fig. 2).

By examining the graphical position of species on this plot with respect to the 'average' expectation given by a linear regression (trendline) the relative vulnerability of species to collision can be judged i.e. species below the line were less likely to die than expected from their flight activity and species above the line were more likely to die than expected (Fig. 2). It is apparent from this that the red kite and, notably, the closely related black kite *Milvus migrans* were apparently not especially vulnerable to collision. Egyptian vultures *Neophron percnopterus* and short-toed eagles *Circaetus gallicus* also died less frequently than expected. Griffin vultures *Gyps fulvus* were by far the most common species seen, most likely due to several wind farms being close to 'muladares' (livestock carcass dumps: which also apparently attracted kites) and because there were several large breeding colonies in the area (Lekuona & Ursúa 2006)[3]. Probably largely as a consequence, griffin vultures were also by far the most common collision victims (Table 2), although they were apparently more likely to die than expected from their flight activity (Fig. 2). Common kestrels *Falco tinnunculus* also appeared relatively more susceptible to collision whilst, interestingly, their close relative the lesser kestrel *F. naumanni* was not (Fig. 2). The American kestrel *F.sparverius* also appears to be relatively susceptible to collision (Whitfield & Band in preparation, Madders & Whitfield unpublished MS).

[3] At least some of these muladares have subsequently been closed down as 'mitigation' against the high collision fatalities of griffins.

CONCLUSION

The initial assumption based on previous studies that avoidance rates in red kites would be similar to most other birds of prey and so likely to be ≥ 98% but < 100% was not contradicted by the results from 13 wind farms in northern Spain, since kites appeared to be less vulnerable to dying through collision than several other European birds of prey. A reasonable conclusion, therefore, would be that an appropriate avoidance rate for red kites should probably be over 98%; likely around 99%. Clearly, however, empirically derived measures should be sought through work at operational wind farms.

REFERENCES

Band, W., Madders, M. & Whitfield, D.P. 2006. Developing field and analytical methods to assess avian collision risk at wind farms. In: de Lucas, M, Janss, G. & Ferrer, M. (eds). *Birds and Wind Power*. Lynx Edicions, Barcelona.

Chamberlain, D., Freeman, S., Rehfisch, M., Fox, T. & Desholm, M. 2005. *Appraisal of Scottish Natural Heritage's Wind Farm Collision Risk Model and its Application*. BTO Research Report 401. British Trust for Ornithology, Thetford, Norfolk.

Chamberlain, D.E., Rehfisch, M.R., Fox, A.D., Desholm, M. & Anthony, S.J. 2006. The effect of avoidance rates on bird mortality predictions made by wind turbine collision risk models. *Ibis* 148 (Suppl. 1), 198-202.

Dürr, T. 2004. Vogelverluste an Windenergieanlagen in Deutschland Daten aus der zentralen Fundkartei der Staatlichen Vogelschutzwarte im Landesumweltamt Brandenburg. (Bird losses at wind energy plants in Germany. From: database of the National Bird Protection Program in the Country Environment office of Brandenburg), Germany.

Erickson, W. 2003. *Updated Information Regarding Bird and Bat Mortality and Risk at New Generation Wind Projects in the West and Midwest*. Presentation at the NWCC Biological Significance Workshop, November 17-18, 2003. Washington, DC. [Available from www.nationalwind.org/events/ wildlife/2003-2/presentations/Erickson.pdf]

Fernley, J., Lowther, S. & Whitfield P. 2006. *A Review of Goose Collisions at Operating Wind Farms and Estimation of the Goose Avoidance Rate*. Unpublished Report by West Coast Energy, Hyder Consulting and Natural Research.

Gauthreaux, S.A. 1995. Standardized assessment and monitoring protocols. In: Proceedings of National Avian-Wind Power Planning Meeting, Denver, Colorado, 20-21 July 1994. Report DE95004090. RESOLVE Inc., Washington, DC, and LGL, Ltd., King City, Ontario, pp. 53-59. [Available from www.nationalwind.org/pubs]

Lekuona, J.M. & Ursúa, C. 2006. Avian mortality in wind plants of Navarra (northern Spain). In: de Lucas, M, Janss, G. & Ferrer, M. (eds). *Birds and Wind Power*. Lynx Edicions, Barcelona.

Madders, M. & Whitfield, D.P. 2006. Upland raptors and the assessment of wind farm impacts. *Ibis* 148 (Suppl. 1), 43-56.

Percival, S.M. 2000. Birds and wind turbines in Britain. *British Wildlife* 12, 8-15.

Smales, I. 2005. *Modelled cumulative impacts on the White-bellied Sea Eagle across the Species' Australian range*. Report for the Department of Environment and Heritage. Project No. 5238. Biosis Research Pty Ltd., Melbourne.

Smales, I. 2006. *Impacts of Avian Collision with Wind Power Turbines: an Overview of the Modelling of Cumulative Risks Posed by Multiple Wind Farms*. Report for the Department of Environment and Heritage. Project No. 5182. Biosis Research Pty Ltd., Melbourne.

Smallwood, K.S. & Thelander, C.G. 2004. *Developing methods to reduce bird mortality in the Altamont Pass Wind Resource Area.* Final Report by BioResource Consultants to the California Energy Commission, Public Interest Energy Research-Environmental Area, Contract No. 500-01-019. [Available from www.energy.ca.gov/pier/final_project_reports/500-04-052.html]

Smallwood, K.S. & Thelander, C.G. 2005. *Bird Mortality at the Altamont Pass Wind Resource Area. March 1998 – September 2001*. National Renewable Energy Laboratory, Colorado. [Available from www.nrel.gov/publications]

Whitfield, D.P. & Madders, M. 2006. A review of the impacts of wind farms on hen harriers *Circus cyaneus* and an estimation of collision avoidance rates. Natural Research Information Note 1 (revised). Natural Research Ltd, Banchory, UK.

Whitfield, D.P & Band, W. In preparation. Estimates of collision avoidance rates at operational wind farms in the USA.

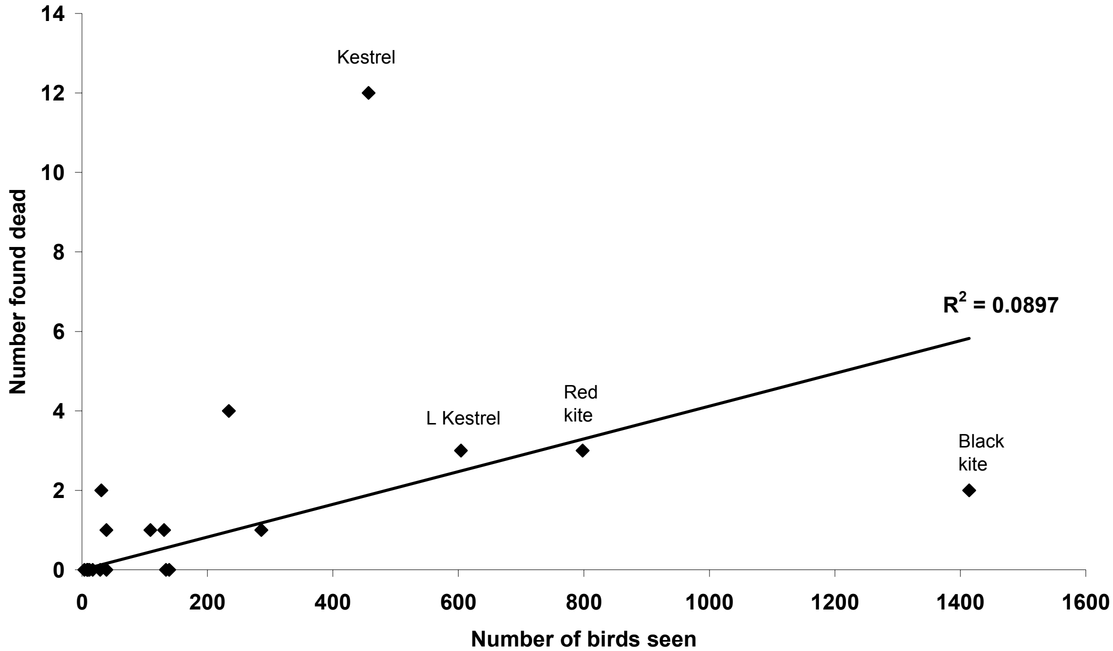

Fig. 1. Plot of the number of individuals seen within study wind farms against number found dead during carcass searches during a three year study at 13 wind farms in Navarra, northern Spain (after Lekuona & Ursúa 2006). Each datum is a bird of prey species (see Table 1), with griffin vulture Gyps fulvus *removed from analysis due to it being a strong outlier. Linear trendline has been forced through the origin. Data point labels indicate selected species (see text).*

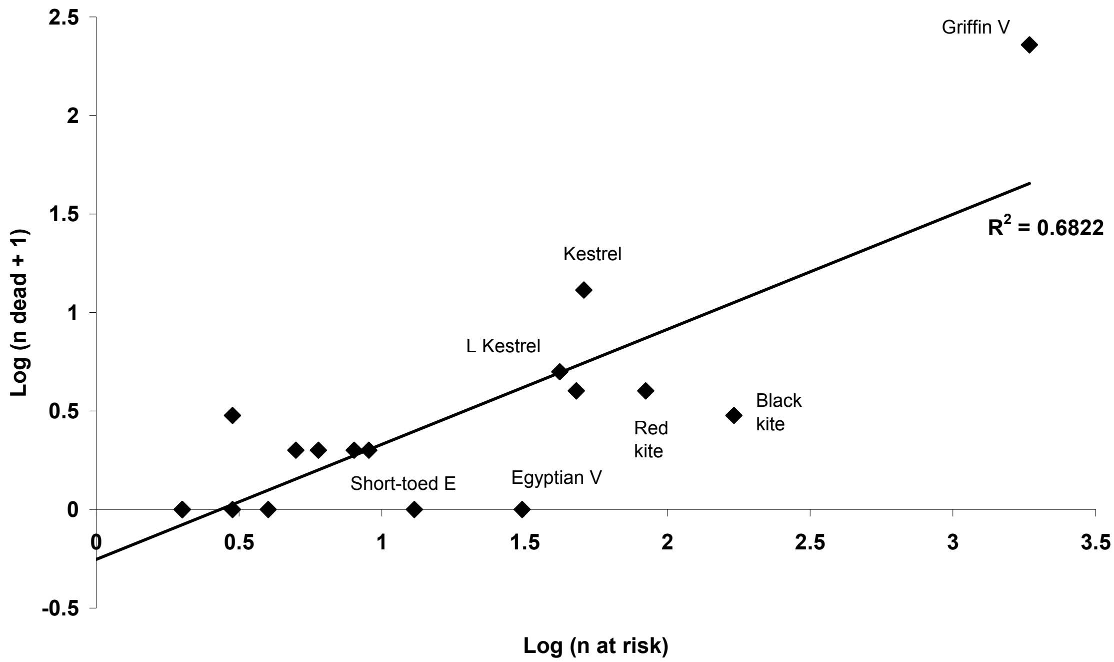

Fig. 2. Plot of log (number of individuals seen at risk of collision) against log (number found dead during carcass searches + 1) during a three year study at 13 wind farms in Navarra, northern Spain (after Lekuona & Ursúa 2006). Each datum is a bird of prey species; species with no birds seen to be at risk were not considered (see Table 1). Data point labels indicate selected species (see text).

Table 1. Preliminary estimates of avoidance rates under the Band CRM for several birds of prey species at USA wind farms.

Species	Avoidance rates		
	Range (%)	Median (%)	N sites
Aquila chrysaetos[1]	98.1 - 100	99.5	4
Buteo jamaicensis[1]	98.9 - 100	99.5	5
Falco sparverius[1]	87.3 - 100	96.9	4
Circus cyaneus[2]	92.3 - 100	99.9	8
Falco mexicanus[1]	99.5 - 100	99.8	2

Notes:
[1] Whitfield & Band (in preparation)
[2] Whitfield & Madders (2006)

Table 2. Summary statistics for birds of prey seen and found dead during a three year study (2000-2002) at 13 wind farms, incorporating 741 turbines, in Navarra, northern Spain. Carcass searches and counts of birds were undertaken at 37 plots containing 277 turbines, and counts of dead birds are uncorrected for search biases such as scavenging. Total seen = all birds seen in the wind farm study plots, N at risk = number of birds seen to be at risk of collision by flying close to rotor blades. Data from Lekuona & Ursúa (2006).

Species	Total seen	% of all birds	N at risk	N dead
Pernis apivorus	638	0.3	0	0
Milvus migrans	1,414	0.7	170	2
Milvus milvus	798	0.4	83	3
Gypaetus barbatus	9	0.0	1	0
Neophron percnopterus	134	0.1	30	0
Gyps fulvus	33,671	16.8	1,853	227
Circaetus gallicus	139	0.1	12	0
Circus aeruginosus	109	0.1	8	1
Circus cyaneus	39	0.0	4	1
Circus pygargus	12	0.0	1	0
Accipiter gentilis	8	0.0	0	0
Accipiter nisus	31	0.0	2	2
Buteo buteo	286	0.1	7	1
Aquila chrysaetos	131	0.1	5	1
Hieraaetus pennatus	234	0.1	41	4
Hieraaetus fasciatus	4	0.0	1	0
Pandion haliaetus	10	0.0	0	0
Falco naumanni	604	0.3	47	3
Falco tinnunculus	457	0.2	50	12
Falco columbarius	39	0.0	3	0
Falco subbuteo	17	0.0	2	0
Falco peregrinus	29	0.0	1	0