Friends of Bob DeGroot,

When Bob died I promised many of you I would let you know when we had plans to scatter his ashes. The plans are in place now and if you can attend that would be wonderful. I request that you please pass this along to anyone who might be interested, as Bob had many friends and I do not want to overlook anyone.

Bob's birthday was in May - the start of Spring, so I felt it was fitting that we say good-bye Saturday May 3rd in an area he loved - Maryland's Old Growth Forest. We may not be able to hike to the interior areas that he loved the most, but we will be in the forest.

I have reserved the small pavilion at the New Germany State Park in Western Maryland for May 3rd. Mapquest gives pretty good directions with the information below.

New Germany State Park
349 Headquarters Lane
Grantsville, MD 21536
301-895-5453

This link is a park layout showing the pavilion
http://www.dnr.state.md.us/publiclands/maps/newgermanymap.html

This link just talks about the park
http://www.dnr.state.md.us/publiclands/western/newgermanyhtml

My plans are to meet at the small pavilion at 10:00 a.m. on May 3rd and then we could carpool to the area closet to the old growth. I am planning on having hot coffee and cookies for everyone. Also, for those who can stay - if you bring a lunch we can meet again in the pavilion after the service and share more Bob stories.

The service will be short and I am hoping folks will have fun stories to share about Bob. The park will not let you have music nor pets. Also there is a $2.00 charge at the gate for all Maryland residents and a $3.00 charge for those from out of state.

If anyone needs/wants to stay overnight - several of us will be at the Casselman Hotel nearby. http://wwwthecasselman.com/hotel.php

Thank you all for the support you have given Bob and MAGIC over the years and I certainly hope you all continue to protect our Wildlife and Forest.

Carolyn Degroot
carolyndegroot@verizon.net
301-340-8348

PS
Be sure to wear comfortable shoes for walking.

A Tough Call – Wind Turbines on State Lands
by Geoff Patton, Ph.D., Acting President

It's baseball season and I'm reminded about umpires. The umpires take the field and are nearly invisible except for disputed calls. Just as there are good calls and bad calls, there are good umps and not-so-good. There are nuances to the calls. Easy calls are, well, easy. There are tough calls that may be muffed by even an experienced ump. When you really appreciate an umpire is when there is a really tough call and they get it right.

Governor Bob O'Malley and John Griffin, Director of the MD DNR made a really tough call on wind turbines and got it right Saturday April 12th. The proposal pitted private commercial interests, posing as "green energy", against local residents and others who saw that cutting down trees in the name of global warming didn't add up. About 1400 residents spoke out on the issue and over 80% saw it the same way, including your MAGIC representatives who spoke against the plan. While this defeated proposal was just the equivalent of a single batter and there will be others to follow, the Governor's and DNR's judgment was sound – a skilled, good call.

One of MAGIC's big concerns with this wind turbine project was the risk to migrating bats and birds – even endangered whooping cranes. At the end of this newsletter, for those inclined to further study, is a summary literature search done by a friend using the key words bird, bat, and wind. Item # 6 of 11 includes an acknowledgment for Dan Boone, a friend of MAGIC's and one of the key people, along with Mark Diehl, who lead the protest against the wind turbine project. Let me know if you desire a copy of this one article.

Look for us at the Rockville Science Day!

Sunday, April 27, 2008, Noon to 5:00 p.m.
Montgomery College, Rockville Campus

Membership Renewal Time

Due to the passing of Bob DeGroot, we are tardy with our Annual Appeal to renew.

Please either go to our website at: http://www.magicalliance.org/ and choose "Support Us" or use this form.

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*Maryland Alliance for Greenway Improvement and Conservation (*MAGIC*)*
Membership Application

Types of Membership

Regular Members: Bona fide organizations that have a substantial interest in the purposes of MAGIC. A Regular Member is represented on the Board by one delegate of its choice. Eligibility for membership shall be determined and may be reviewed at any time by the Board.

Associate Members: Bona fide organizations that have a substantial interest in the purposes of MAGIC, but do not choose to be represented on the Board. An Associate Member may be represented at meetings by an observer of its choice. Eligibility for. membership shall be determined and may be reviewed at any time by the Board. MAGIC will not represent an Associate Member as having agreed with its positions.

Individual Members: Any individual whose interests are in harmony with the purpose of MAGIC may become an Individual Member and participate in the activities of MAGIC. Eligibility for such participation is determined and may be reviewed at any time by the Board. An Individual Member may serve as a Trustee-at-Large as provided in the By-laws, or as a member of one or more committees.

___ Individual Member-$25
___ Family-$35
___ Limited Income-Student-$10
___ Request for Free Membership
___ Regular Organizational Member-$50
___ Associate Organizational Member-$50
___ Benefactor - $1,000
___ Patron Member - $500
___ $25 Donation
___ $50 Donation
___$100 Donation
___ Other

PLEASE MAKE CHECKS PAYABLE TO: MAGIC, Inc. and send to Cheryl Kassed, Treasurer, 2208 Parker Ave, Wheaton, MD 20902
Organization or Individual Member Name:_____
Address:_____
Organization Signer:_____Office Held:_____
Phone:_____E-Mail:_____

[1]
Record 1 of 11
Arnett, EB; Brown, WK; Erickson, WP; Fiedler, JK; Hamilton, BL; Henry, TH; Jain, A; Johnson, GD; Kerns, J; Koford, RR; Nicholson, CP; O'Connell, TJ; Piorkowski, MD; Tankersley, RD. 2008. Patterns of bat fatalities at wind energy facilities in North America. *JOURNAL OF WILDLIFE MANAGEMENT* 72 (1): 61-78.
Author Full Name(s): Arnett, Edward B.; Brown, W. Kent; Erickson, Wallace P.; Fiedler, Jenny K.; Hamilton, Brenda L.; Henry, Travis H.; Jain, Aaftab; Johnson, Gregory D.; Kerns, Jessica; Koford, Rolf R.; Nicholson, Charles P.; O'Connell, Timothy J.; Piorkowski, Martin D.; Tankersley, Roger D., Jr.
Abstract: Wind has become one of the fastest growing sources of renewable energy worldwide, but widespread and often extensive fatalities of bats have increased concern regarding the impacts of wind energy development on bats and other wildlife. We synthesized available information on patterns of bat fatalities from a review of 21 postconstruction fatality studies conducted at 19 facilities in 5 United States regions and one Canadian province. Dominance of migratory, foliage- and tree-roosting lasiurine species (e.g., hoary bat [Lasiurus cincreus]) killed by turbines was consistent among studies. Bat fatalities, although highly variable and periodic, consistently peaked in late summer and fall, coinciding with migration of lasiurines and other species. A notable exception was documented fatalities of pregnant female Brazilian free-tailed bats (Tadarida brasiliensis) in May and June at a facility in Oklahoma, USA, and female silver-haired bats (Lasionycteris noctivagans) during spring in Tennessee, USA, and Alberta, Canada. Most studies reported that fatalities were distributed randomly across turbines at a site, although the highest number of fatalities was often found near the end Of turbine strings. Two studies conducted simultaneously in the same region documented similar timing of fatalities between sites, which suggests broader patterns of collisions dictated by weather, prey abundance, or other factors. None of the studies found differences in bat fatalities between turbines equipped with lighting required by the Federal Aviation Administration and turbines that were unlit. All studies that addressed relationships between bat fatalities and weather patterns found that most bats were killed on nights with low wind speed (<6 m/sec) and that fatalities increased immediately before and after passage of storm fronts. Weather patterns may be predictors of bat activity and fatality; thus, mitigation efforts that focus on these high-risk periods could reduce bat fatality substantially. We caution that estimates of bat fatality are conditioned by length of study and search interval and that they are biased in relation to how searcher efficiency, scavenger removal, and habitat differences were or were not accounted for. Our review will assist managers, biologists, and decision-makers with understanding unifying and unique patterns of bat fatality, biases, and limitations of existing efforts, and it will aid in designing future research needed to develop mitigation strategies for minimizing or eliminating bat fatality at wind facilities.
Times Cited: 1
Record 2 of 11
Horn, JW; Arnett, EB; Kunz, TH. 2008. Behavioral responses of bats to operating wind turbines. *JOURNAL OF WILDLIFE MANAGEMENT* 72 (1): 123-132.
Author Full Name(s): Horn, Jason W.; Arnett, Edward B.; Kunz, Thomas H.
Abstract: Wind power is one of the fastest growing sectors of the energy industry. Recent studies have reported large numbers of migratory tree-roosting bats being killed at utility-scale wind power facilities, especially in the eastern United States. We used thermal infrared (TIR) cameras to assess the flight behavior of bats at wind turbines because this technology makes it possible to observe the nocturnal behavior of bats and birds independently of supplemental light sources. We conducted this study at the Mountaineer Wind Energy Center in Tucker County, West Virginia, USA, where hundreds of migratory tree bats have been found injured or dead beneath wind turbines. We recorded nightly 9-hour sessions of TIR video of operating turbines from which we assessed altitude, direction, and types of flight maneuvers of bats, birds, and insects. We observed bats actively foraging near operating turbines, rather than simply passing through turbine sites. Our results indicate that bats 1) approached both rotating and nonrotating blades, 2) followed or were trapped in blade-tip vortices, 3) investigated the various parts of the turbine with repeated fly-bys, and 4) were struck directly by rotating blades. Blade rotational speed was a significant negative predictor of collisions with turbine blades, suggesting that bats may be at higher risk of fatality on nights with low wind speeds.
Times Cited: 0
Record 3 of 11
Smallwood, KS; Thelander, C. 2008. Bird mortality in the Altamont Pass Wind Resource Area, California. *JOURNAL OF WILDLIFE MANAGEMENT* 72 (1): 215-223.

Author Full Name(s): Smallwood, K. Shawn; Thelander, Carl
Abstract: The 165-km(2) Altamont Pass Wind Resource Area (APWRA) in west-central California includes 5,400 wind turbines, each rated to generate between 40 kW and 400 kW of electric power, or 580 MW total. Many birds residing or passing through the area are killed by collisions with these wind turbines, We searched for bird carcasses within 50 m of

4,074 wind turbines for periods ranging from 6 months to 4.5 years. Using mortality estimates adjusted for searcher detection and scavenger removal rates, we estimated the annual wind turbine-caused bird fatalities to number 67 (80% CI = 25-109) golden eagles (Aquila chrysaetos), 188 (80% CI 116-259) red-tailed hawks (Buteo jamaicensis), 349 (80% CI = -49 to 749) American kestrels (Falco sparverius), 440 (80% CI = -133 to 1,013) burrowing owls (Athene cunicularia hypugaea), 1,127 (80% CI = -23 to 2,277) raptors, and 2,710 (80% CI = -6,100 to 11,520) birds. Adjusted mortality estimates were most sensitive to scavenger removal rate, which relates to the amount of time between fatality searches. New on-site studies of scavenger removal rates might warrant revising mortality estimates for some smallbodied bird species, although we cannot predict how the mortality estimates would change. Given the magnitude of our morolity estimates, regulatory agencies and the public should decide whether to enforce laws intended to protect species killed by APWRA wind turbines, and given the imprecision of our estimates, directed research is needed of sources of error and bias for use in studies of bird collisions wherever wind farms are developed. Precision of mortality estimates could be improved by deploying technology to remotely detect collisions and by making wind turbine power output data available to researchers so that the number of fatalities can be related directly to the actual power output of the wind turbine since the last fatality search.

Times Cited: 0

Record 4 of 11

Kunz, TH; Arnett, EB; Cooper, BM; Erickson, WP; Larkin, RP; Mabee, T; Morrison, ML; Strickland, MD; Szewczak, JM. 2007. Assessing impacts of wind-energy development on nocturnally active birds and bats: A guidance document. *JOURNAL OF WILDLIFE MANAGEMENT* 71 (8): 2449-2486.

Author Full Name(s): Kunz, Thomas H.; Arnett, Edward B.; Cooper, Brian M.; Erickson, Wallace P.; Larkin, Ronald P.; Mabee, Todd; Morrison, Michael L.; Strickland, M. Dale; Szewczak, Joseph M.

Abstract: Our purpose is to provide researchers, consultants, decision-makers, and other stakeholders with guidance to methods and metrics for investigating nocturnally active birds and bats in relation to utility-scale wind-energy development. The primary objectives of such studies are to 1) assess potential impacts on resident and migratory species, 2) quantify fatality rates on resident and migratory populations, 3) determine the causes of bird and bat fatalities, and 4) develop, assess, and implement methods for reducing risks to bird and bat populations and their habitats. We describe methods and tools and their uses, discuss limitations, assumptions, and data interpretation, present case studies and examples, and offer suggestions for improving studies on nocturnally active birds and bats in relation to wind-energy development. We suggest best practices for research and monitoring studies using selected methods and metrics, but this is not intended as cookbook. We caution that each proposed and executed study will be different, and that decisions about which methods and metrics to use will depend upon several considerations, including study objectives, expected and realized risks to bird and bat populations, as well as budgetary and logistical considerations. Developed to complement and extend the existing National Wind Coordinating Committee document "Methods and Metrics for Assessing Impacts of Wind Energy Facilities on Wildlife" (Anderson et al. 1999), we provide information that stakeholders can use to aid in evaluating potential and actual impacts of wind power development on nocturnally active birds and bats. We hope that decision-makers will find these guidelines helpful as they assemble information needed to support the permitting process, and that the public will use this guidance document as they participate in the permitting processes. We further hope that the wind industry will find valuable guidance from this document when 1) complying with data requirements as a part of the permitting process, 2) evaluating sites for potential development, 3) assessing impacts of operational wind-energy facilities, and 4) mitigating local and cumulative impacts on nocturnally active birds and bats.

Times Cited: 2

Record 5 of 11

Kuvlesky, WP; Brennan, LA; Morrison, ML; Boydston, KK; Ballard, BM; Bryant, FC. 2007. Wind energy development and wildlife conservation: Challenges and opportunities. *JOURNAL OF WILDLIFE MANAGEMENT* 71 (8): 2487-2498.

Author Full Name(s): Kuvlesky, William P., Jr.; Brennan, Leonard A.; Morrison, Michael L.; Boydston, Kathy K.; Ballard, Bart M.; Bryant, Fred C.

Abstract: Wind energy development represents significant challenges and opportunities in contemporary wildlife management. Such challenges include the large size and extensive placement of turbines that may represent potential hazards to birds and bats. However, the associated infrastructure required to support an array of turbines-such as roads

and transmission lines-represents an even larger potential threat to wildlife than the turbines themselves because such infrastructure can result in extensive habitat fragmentation and can provide avenues for invasion by exotic species. There are numerous conceptual research opportunities that pertain to issues such as identifying the best and worst placement of sites for turbines that will minimize impacts on birds and bats. Unfortunately, to date very little research of this type has appeared in the peer-reviewed scientific literature; much of it exists in the form of unpublished reports and other forms of gray literature. In this paper, we summarize what is known about the potential impacts of wind farms on wildlife and

identify a 3-part hierarchical approach to use the scientific method to assess these impacts. The Lower Gulf Coast (LGC) of Texas, USA, is a region currently identified as having a potentially negative impact on migratory birds and bats, with respect to wind farm development. This area is also a region of vast importance to wildlife from the standpoint of native diversity, nature tourism, and opportunities for recreational hunting. We thus use some of the emergent issues related to wind farm development in the LGC-such as siting turbines on cropland sites as opposed to on native rangelands-to illustrate the kinds of challenges and opportunities that wildlife managers must face as we balance our demand for sustainable energy with the need to conserve and sustain bird migration routes and corridors, native vertebrates, and the habitats that support them.

Times Cited: 0

Record 6 of 11

Kunz, TH; Arnett, EB; Erickson, WP; Hoar, AR; Johnson, GD; Larkin, RP; Strickland, MD; Thresher, RW; Tuttle, MD. 2007. Ecological impacts of wind energy development on bats: questions, research needs, and hypotheses. *FRONTIERS IN ECOLOGY AND THE ENVIRONMENT* 5 (6): 315-324.

Author Full Name(s): Kunz, Thomas H.; Arnett, Edward B.; Erickson, Wallace P.; Hoar, Alexander R.; Johnson, Gregory D.; Larkin, Ronald P.; Strickland, M. Dale; Thresher, Robert W.; Tuttle, Merlin D.

Abstract: At a time of growing concern over the rising costs and long-term environmental impacts of the use of fossil fuels and nuclear energy, wind energy has become an increasingly important sector of the electrical power industry, largely because it has been promoted as being emission-free and is supported by government subsidies and tax credits. However, large numbers of bats are killed at utility-scale wind energy facilities, especially along forested ridgetops in the eastern United States. These fatalities raise important concerns about cumulative impacts of proposed wind energy development on bat populations. This paper summarizes evidence of bat fatalities at wind energy facilities in the US, makes projections of cumulative fatalities of bats in the Mid-Atlantic Highlands, identifies research needs, and proposes hypotheses to better inform researchers, developers, decision makers, and other stakeholders, and to help minimize adverse effects of wind energy development.

Times Cited: 3

Record 7 of 11

Stewart, GB; Pullin, AS; Coles, CF. 2007. Poor evidence-base for assessment of windfarm impacts on birds. *ENVIRONMENTAL CONSERVATION* 34 (1): 1-11.

Author Full Name(s): Stewart, Gavin B.; Pullin, Andrew S.; Coles, Christopher F.

Abstract: Concerns about anthropogenic climate change have resulted in promotion of renewable energy sources, especially wind energy. A concern raised against widespread windfarm development is that it may negatively impact bird populations as a result of bird collision with turbines, habitat loss and disturbance. Using systematic review methodology bird abundance data were synthesized from 19 globally-distriuted windfarms using meta-analysis. The effects of bird taxon, turbine number, power, location, latitude, habitat type, size of area, time since operation, migratory status of the species and quality of evidence were analysed using meta-regression. Although the synthesized data suggest a significant negative impact of windfarms on bird abundance, there is considerable variation in the impact of individual windfarm sites on individual bird species, and it is unclear if the negative impact is a decline in population abundance or a decline in use owing to avoidance. Anscriformes experienced greater declines in abundance than other taxa, followed by Charadriiformes, Falconiformes and Accipitriformes, and Passeriformes. Time since windfarms commenced operation also had a significant impact on bird abundance, with longer operating times resulting in greater declines in abundance than short operating times. Other variables, including turbine number and turbine power either had very weak but statistically significant effects or did not have a significant effect on bird abundance. Windfarms may have significant biological impacts, especially over longer time scales, but the evidence-base is poor, with many studies being methodologically weak, and more long-term impact assessments are require. There is clear evidence that Anseriformes (wildfowl) and Charadriiformes (waders) experience declines in abundance, suggesting that a precautionary approach should be adopted to windfarm development near aggregations of these taxa in offshore and coastal locations. The impact of windfarm developments on bird populations must also be viewed in the context of the possible impact of climate change in the absence of windfarms.

Times Cited: 0

Record 8 of 11

Larsen, JK; Guillemette, M. 2007. Effects of wind turbines on flight behaviour of wintering common eiders: implications for habitat use and collision risk. *JOURNAL OF APPLIED ECOLOGY* 44 (3): 516-522.

Author Full Name(s): Larsen, Jesper K.; Guillemette, Magella

Abstract: 1.Wind energy is a fast-growing renewable energy source and many offshore wind parks will be erected in shallow waters (< 40 m deep) where various coastal bird species are found. The two main issues regarding offshore wind farms and birds are disturbance and collision risk. We studied the effect of wind turbines on the flight behaviour of

wintering common eiders Somateria mollissima in order to identify the properties that cause disturbance and the factors that may increase their risk of collision.
2. The study was conducted at Tuno Knob offshore wind park in the Kattegat, Denmark. We attracted birds though the use of decoys located at increasing distances from the wind park. To discriminate between the potential disturbance effect of the standing towers from that of the revolving rotor blades, wind turbines were switched on or off alternately during 10 experimental trials.
3. Common eiders reacted strongly to the presence of wind turbines. The number of flying birds was significantly related to flight corridor location and position of the decoy group. That behavioural reaction was interpreted to be a consequence of their high speed and low-manoeuvrability flight occurring within the vertical height range of the wind turbines. The number of landing birds also reacted to the position of the decoy group in relation to proximity to the turbines, with the greatest effects observed within the wind park. Such avoidance behaviour might decrease use of otherwise suitable habitat.
4. The movement and noise of rotors affected neither the number of common eiders flying within corridors nor the number of birds reacting to decoys. This suggests that the avoidance behaviour observed was caused by the presence of the structures themselves and that eiders use vision when avoiding human-made structures.
5. Synthesis and applications. This study has demonstrated that common eiders avoid flying close to or into the Tuno Knob wind park. This behaviour may result in a reduction in habitat availability within and around wind parks, and raises concerns about the possible impact of the extensive development of large-scale wind parks in shallow offshore waters, which are the main feeding areas for sea ducks and other marine birds. Our results indicate that the disturbance effect of revolving rotor blades is negligible during daylight hours but highlights the need for studies to be carried out during hours of darkness and conditions of poor visibility (e.g. fog and snow). Until more insight is gained, we recommend caution when planning wind parks in areas of high sea duck densities.
Times Cited: 0
Record 9 of 11
Barclay, RMR; Baerwald, EF; Gruver, JC. 2007. Variation in bat and bird fatalities at wind energy facilities: assessing the effects of rotor size and tower height. *CANADIAN JOURNAL OF ZOOLOGY-REVUE CANADIENNE DE ZOOLOGIE* 85 (3): 381-387.
Author Full Name(s): Barclay, Robert M. R.; Baerwald, E. F.; Gruver, J. C.
Abstract: Wind energy is a rapidly growing sector of the alternative energy industry in North America, and larger, more productive turbines are being installed. However, there are concerns regarding bird and bat fatalities at wind turbines. To assess the influence of turbine size on bird and bat fatalities, we analyzed data from North American wind energy facilities. Diameter of the turbine rotor did not influence the rate of bird or bat fatality. The height of the turbine tower had no effect on bird fatalities per turbine, but bat fatalities increased exponentially with tower height. This suggests that migrating bats fly at lower altitudes than nocturnally migrating birds and that newer, larger turbines are reaching that airspace. Minimizing tower height may help minimize bat fatalities. In addition, while replacing older, smaller turbines with fewer larger ones may reduce bird fatalities per megawatt, it may result in increased numbers of bat fatalities.
Times Cited: 4
Record 10 of 11
Drewitt, AL; Langston, RHW. 2006. Assessing the impacts of wind farms on birds. *IBIS* 148: 29-42, Suppl. 1.
Author Full Name(s): Drewitt, Allan L.; Langston, Rowena H. W.
Abstract: The potential effects of the proposed increase in wind energy developments on birds are explored using information from studies of existing wind farms. Evidence of the four main effects, collision, displacement due to disturbance, barrier effects and habitat loss, is presented and discussed. The consequences of such effects may be direct mortality or more subtle changes to condition and breeding success. The requirements for assessing the impact of future

developments are summarized, including relevant environmental legislation and appropriate methods for undertaking baseline surveys and post-construction monitoring, with particular emphasis on the rapidly developing area of offshore wind farm assessments. Mitigation measures which have the potential to minimize impacts are also summarized. Finally, recent developments in the monitoring and research of wind energy impacts on birds are outlined and some areas for future work are described.
Times Cited: 5
Record 11 of 11
Madders, M; Whitfield, DP. 2006. Upland raptors and the assessment of wind farm impacts. *IBIS* 148: 43-56, Suppl. 1.
Author Full Name(s): Madders, Mike; Whitfield, D. Philip
Abstract: Government targets on renewable energy coupled with anthropogenic constraints on development have

resulted in a surge in proposals to locate wind farms in upland areas, where they may conflict with the wellbeing of scarce or rare bird species including raptors. European and UK legislation demand that the effects of wind farm developments, both individually and in combination, be assessed to determine the level of impact on these species. The principle adverse effects of wind farms on raptors, as for other terrestrial birds, potentially involve disturbance (displacement or barrier impacts) or collision fatality. Few long-term studies on such effects of wind farms have been undertaken. We review available research results on displacement of raptors, which primarily involve foraging birds, and conclude that most studies indicate that displacement appears to be negligible, although some notable exceptions occur and more research is needed. There is also a need for better understanding of the numbers of birds likely to be killed through collision with turbine rotors at the site level in order to inform planning decisions, although models of bird distribution at several spatial scales can be used to circumvent potential difficulties when locating turbines. Modelling approaches have also been developed that attempt to quantify the theoretical risk of collision. One such approach, the Band model, is a valuable tool for impact assessment and its use is now widespread in the UK. However, there are practical problems associated with gathering the data required to run the model and numerous assumptions must be made concerning bird behaviour. This can lead to deficiencies in the input parameters which potentially have a large effect on the model outputs. Hence, we make recommendations for potential improvements, such as quantifying error in flight height estimation, training of observers in acuity skills, quantifying bird detection-distance functions, and research on factors influencing activity budgets and flight behaviour. In addition, the model outputs are usually adjusted to take account of turbine avoidance by birds and this aspect of birds' behaviour is poorly understood. As a result of these limitations, collision predictions are only indicative, and more reliable in some situations, and for some species, than others.