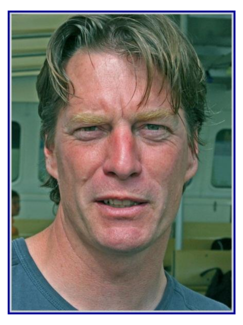
Prediction and Assessment of collision risks at wind turbines in Germany (German acronym: “PROGRESS”)



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Financed by the German Ministry of Environment (BMU) a joint venture project of the collision risk of birds at wind mill power plants is scheduled from Nov 2011 to Nov 2014 by three German consultancies BioConsult SH, ARSU and IfAÖ. The study addresses the collision rate of birds with intensive systematic line transect search of collision victims. Having finished the fieldwork 54 wind farm-seasons (time frames of 12 weeks) will be the fundament of the analysis. Correction factors for detection probability and carcass removal in different crop coverage will be deduced from experiments. Systematic vantage point watches will add avoidance rate (short range escape movements caused by rotor) to the BAND-Model (Band et al. 2007). The output of the model will be evaluated by the actual number of victims. The overall aim of the project is to bring together carcass search in the field, experiments for correction factors, empirical values for avoidance rate for an advanced modeling with iterated cross-validation. Finally the modeled number of victim will be used in species specific matrix population models to predict the significance of the mortality added by the actual and future number of wind turbines. Whereas most other studies are carried out in the context of environmental impact assessments of wind farms during the approval process with no wind turbines present, this study yielded true bird collision rates at existing wind turbines.
The project aims to give a well justified answer the relevance of the impact of bird mortality at wind turbines in Germany.

Modules of the project

Module 1: Field work: search of collision fatalities with correction factors (search efficiency + removal rates) and vantage point watches (this poster)

Aim: assessment of number of collisions in relation to species composition, abundance and avoidance rate

Module 2: Desk top: population models

Aim: prognosis and assessment of consequences on population level

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Module 3: Desk top: Use/Evaluation of BAND-model in the framework of the planning process of wind power plants

Aim: development of methodological guidelines for future fieldwork, risk prognosis and legal assessment

Target species of the project are:

❍ Birds of prey
(most common taxon of documented fatalities in the German database of collision fatalities)

❍ Large Birds
(vulnerability due to generally small population size)

❍ Species breeding and roosting in wind farm areas (possible concern)

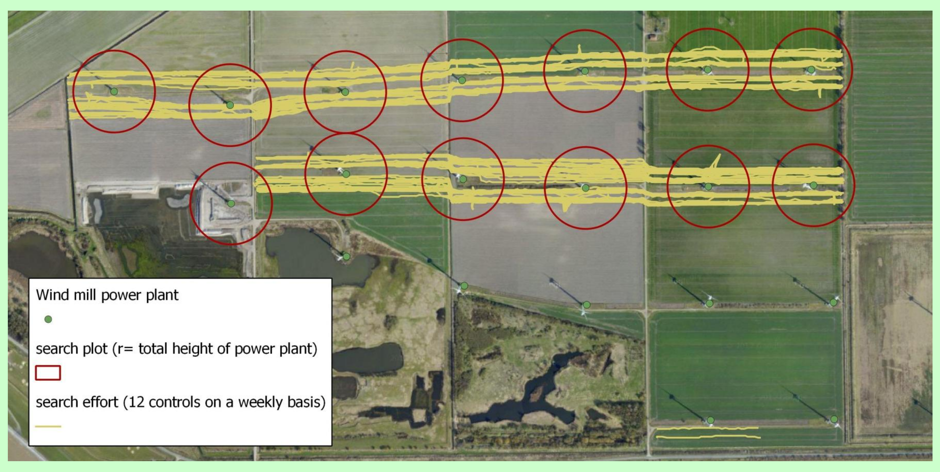
Progress of the project PROGRESS:

Season	number of wind farms studied
Spring 2012	9
Autumn 2012	12
Spring 2013	12
Autumn 2013	12
Spring 2014	9
total	54

Walk the line
Transect search of collision fatalities

„No slough too tough, no creek to deep“

Within a season, we conducted 12 controls on a weekly basis walking linear transects, which were GPS-logged and intersected with different classes of vegetation coverage and the search plot (r = height of power plant) with the help of GIS-software.

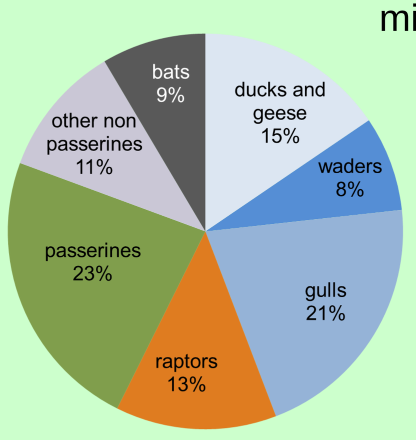


Transect design of line transect distance sampling (above), list of collision fatalities after two field seasons with target species in red (below) and taxa distribution of collision fatalities.

Bird species	number
Black-headed gull	14
Mallard	14
Common buzzard	11
Wood pigeon	7
Starling	6
Herring gull	6
Lapwing	5
Rock dove	4
Lesser black-backed gull	4
Kestrel	4
Blue tit	3
Skylark	3
Golden plover	3
Red kite	3
Common gull	3
Goldcrest	2
Grey goose	2
Grey heron	2
Barn swallow	2
Black bird	1
Wagtail	1
Common snipe	1
Coot	1
Magpie	1
Curlew	1
Raven	1
Crane	1
Teal	1
Blackcap	1
Dotterel	1
Egyptian goose	1
Carrion crow	1
Partridge	1
Reed bunting	1
Robin	1
Song thrush	1
Firecrest	1
Sparrow hawk	1
Goldfinch	1
Sand martin	1
all fatalities	119

total search effort [km]	number of fatalities [n]	encounter rate [fatality/km]
3083	119	25

On average, we found 1 fatality every 25 km.



The species list of fatalities (left) was clearly dominated by staging birds. Merely few songbirds (e. g. Gold crest, Blue tit) can be related to the broad-fronted (nocturnal) mass migration of songbirds.

Can searchers compete with foxes?
Experiments of carcass removal rates by scavengers / decaying process

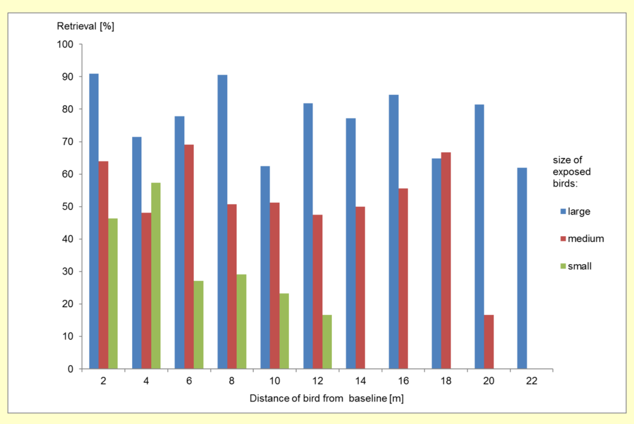
We deposited bird carcasses (mostly road kills) and controlled their presence and detectability.

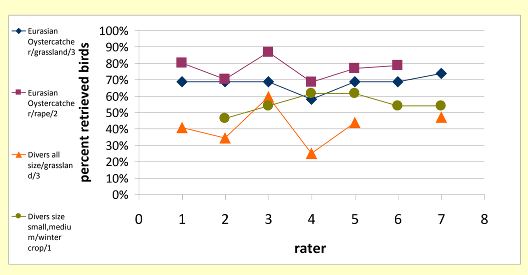
Bird size	e.g.	value	lower CI	upper CI
(very) large	*Anser anser*	0.989	0.968	0.996
large	*Buteo buteo*	0.956	0.935	0.970
medium	*Larus ridibundus*	0.926	0.915	0.935
small	*Carduelis chloris*	0.913	0.908	0.918
(very) small	*Regulus regulus*	0.911	0.907	0.914

Daily persistence rates for dead birds of different size – based on the best model: Phi(body mass) p (wind farm). Removal rates of larger birds are lower.

The hunting of the lark
Testing search efficiency and inter-rater reliability

The rate of detected carcasses in relation to their total number depends on many different parameters. We chose an experimental approach and deposited birds (mostly road kills) of different size classes (small, intermediate, large) in different vegetation coverage to estimate the search efficiency.

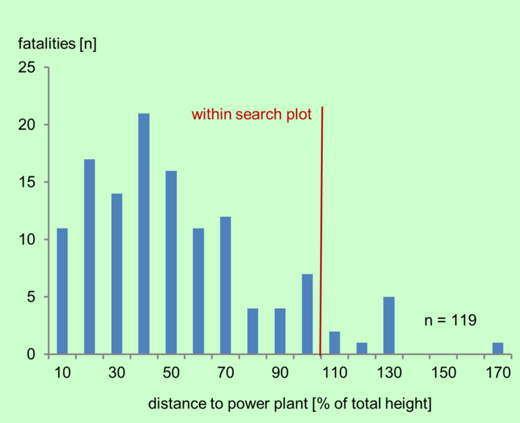




Retrieval experiments % ~ distance of bird from baseline: no small bird was seen beyond 12 m (left), the average level of agreement was 0.86%: bird size and distance to baseline are more important than the individual searcher (right).

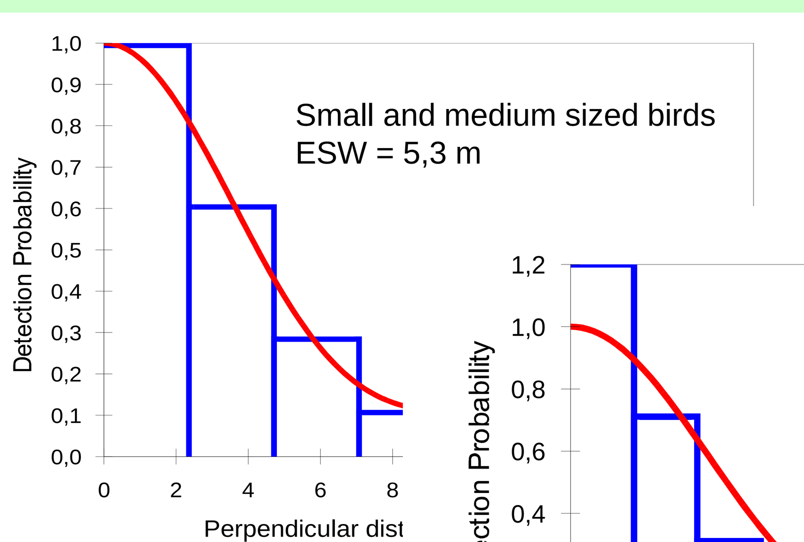
An obvious collision victim: this Golden plover was cut in half by a rotor

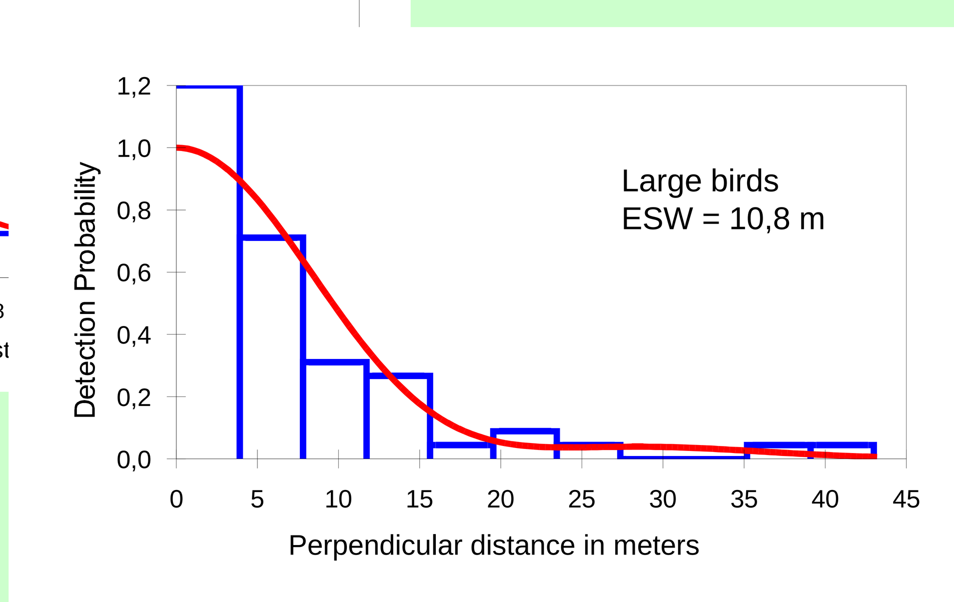
Collision fatality and/or predation of a Black-headed gull ?



Collision or predation?

We pragmatically refer to the vicinity of the carcass/ the feathers to the power plant and consider items within the search plot (r = total height) as collision victims.





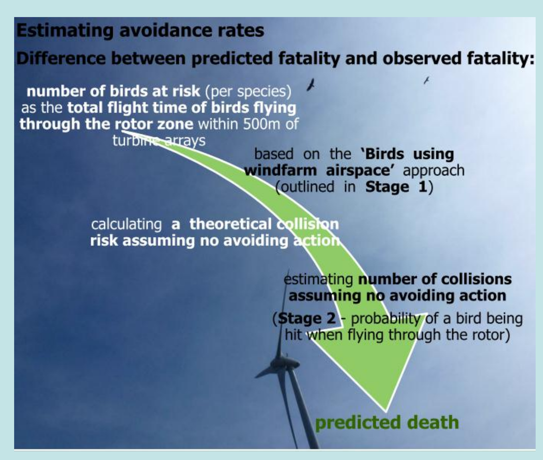
Line transect distance sampling (software DISTANCE) calculates the Effective Strip Width of actually found fatalities. Small and medium sized birds: 5,3 m, large birds: 10,8 m. An extrapolation of number of fatalities to areas without search effort is thus feasible.

Conquer the perspective!
Observation of flight paths and avoidance rates at Vantage points

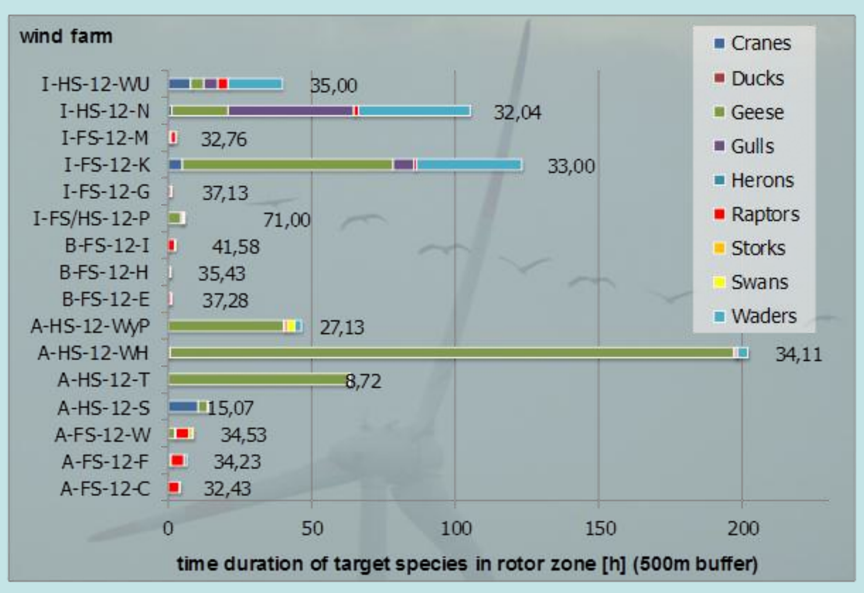
Flock of swans flying in the danger area (rotor zone)

Common models of collision risk (like the “Band model”) use the numbers or density of birds flying at turbine height (i.e. within the swept area of the turbine blades). This collision risk modelling is strongly influenced by the avoidance rate considered. As a result, a range of avoidance rates are typically used in EIAs to indicate the possible risks of collision. These “correction factors” are calculated indirectly by comparing the number of observed collisions to the number of predicted deaths. So far direct behavioural observations of avoidance behaviours are rarely taken into consideration.

We carry out parallel visual observations (vantage point watches) between 2012 and 2014 in 54 wind farms, to assess bird flight activity in the field (including time spent in rotor zone), flight altitudes (in three height classes based on rotor swept area) and detours of flight paths around the wind turbines (module 1).



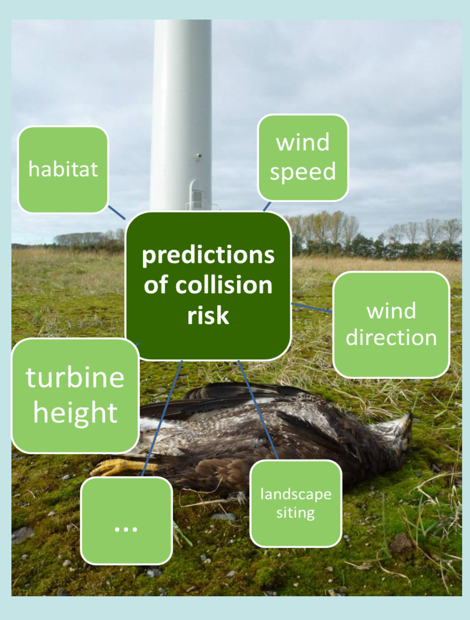
$$\text{avoidance rate} = 1 - \left[\frac{\text{corrected estimate of actual mortality per caracass search period}}{\text{predicted deaths assuming no avoidance during caracass search period}}\right]$$



Birds at risk

Duration (in hours) in the danger area (number of birds observed in rotor zone multiplied by the stopped seconds) to estimate collision risk in the different wind farms of the project.

The current status of data input in the project database regarding the density of target birds flying at turbine height in the 500m buffer around the wind farm is shown above. This addresses the expected relationship between bird density and bird collision rate. Just like fatality rates vary widely regionally across wind farms, there are clear regional distinctions in the observed species composition, which is also owing to the methodological approach of the wind farm selection.



Whilst collision and mortality rates might be used to provide a surrogate for avoidance rates, they do not reflect actual avoiding behaviour. Thus that calculation procedure is subject to substantial observer, stochastic and systematic error. Taking account of our observations of the micro-avoidance of individual turbines within a wind farm in addition to our calculations we might gain insight into collision risks of different species. Summing up the module 3 of PROGRESS is targeted on the use/evaluation of the BAND-model in the framework of the planning process of wind power plants as we need to expand our understanding of species-specific interactions with turbines. The main aim is the development of methodological guidelines for future fieldwork, risk prognosis and legal assessment.