A large-scale, multispecies assessment of avian mortality rates at onshore wind turbines in northern Germany (PROGRESS)

T. Grünkorn
Modules and aims of PROGRESS

Module 1: Field work:
- search of collision fatalities, estimation of correction factors
- flight activity data by vantage point watches

Aim: estimates of species specific fatality numbers in relation to flight activity

Module 2: Desk top: population models

Aim: prognosis and assessment of consequences on population level

Module 3: Evaluation of BAND-model in the framework of the planning process of onshore wind farms

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

Study period:
spring 2012 to spring 2014 (2.5 years)
55 wind farm seasons

Field season:
12 controls on a weekly basis
(12 weeks) in suitable time frames

Design:
transect lines of 2 persons 20 m apart
(logged track)

From line to area:
strip transect
(transect line buffered with 10 m)
Distribution of investigated wind farms

46 wind farms / 55 wind farm seasons
Search method

Walk the line ...
Search method

Yellow = logged transects (12 surveys)
Red = wind turbine with search plot (r = 100 m)
## Search effort, surface conditions

<table>
<thead>
<tr>
<th>Category</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>no vegetation, bare grounds</td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>growing seedlings of e.g. winter wheat</td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>high vegetation, complete soil coverage</td>
</tr>
</tbody>
</table>
Obvious fatality (Golden Plover)

Predation of bird or predation of carcass (Black-headed Gull)?
Excluded fatalities:
- birds found beyond search plot,
- birds found at the first day of a campaign of 12 weeks,
- non-effort birds at surplus visits of wind farms.
Distribution of 291 fatalities in 55 wind farm seasons
Ranking of fatalities – top ten

Fatality species are common staging birds, feeding and roosting in wind farms

- very few songbirds (e.g. thrushes) of broad-front (nocturnal) migration

**PROGRESS**

<table>
<thead>
<tr>
<th>species</th>
<th>number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood Pigeon</td>
<td>41</td>
</tr>
<tr>
<td>Mallard</td>
<td>39</td>
</tr>
<tr>
<td>Common Buzzard</td>
<td>25</td>
</tr>
<tr>
<td>Black-headed Gull</td>
<td>18</td>
</tr>
<tr>
<td>Starling</td>
<td>15</td>
</tr>
<tr>
<td>Lapwing</td>
<td>12</td>
</tr>
<tr>
<td>Herring Gull</td>
<td>12</td>
</tr>
<tr>
<td>Golden Plover</td>
<td>10</td>
</tr>
<tr>
<td>Skylark</td>
<td>10</td>
</tr>
<tr>
<td>Rock Dove</td>
<td>9</td>
</tr>
</tbody>
</table>

n total = 291 fatalities
65 species
2,5 years
this study

**German data base**

<table>
<thead>
<tr>
<th>species</th>
<th>number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common Buzzard</td>
<td>289</td>
</tr>
<tr>
<td>Red Kite</td>
<td>250</td>
</tr>
<tr>
<td>White-tailed Eagle</td>
<td>99</td>
</tr>
<tr>
<td>Mallard</td>
<td>91</td>
</tr>
<tr>
<td>Swift</td>
<td>86</td>
</tr>
<tr>
<td>Black-headed Gull</td>
<td>83</td>
</tr>
<tr>
<td>Wood Pigeon</td>
<td>79</td>
</tr>
<tr>
<td>Skylark</td>
<td>74</td>
</tr>
<tr>
<td>Herring Gull</td>
<td>69</td>
</tr>
<tr>
<td>Starling</td>
<td>68</td>
</tr>
</tbody>
</table>

n total = 2,145 fatalities
129 species
approx.15 years of data collection
T. Dürr, Dec. 2014
Need for correction factors

Carcass searches yield a number of found collision victims, however
- not every carcass is found
  => proportion searched area (<1)
  => search efficiency
- carcasses disappear before searches
  => persistence rate

Aim:

Estimate the total number of bird fatalities in wind farm areas.
Correction for incomplete area coverage

proportion of searched area
⇒ wind farm area
⇒ 20m-distance ring
⇒ vegetation class
Correction for search efficiency

open: inconspicuous birds

closed: conspicuous birds

T. Grünkorn CWW Berlin 2015
Correction for carcass removal

Select a species with given body mass and colouration:

average predicted daily persistence rates across all wind farm areas (examples).

<table>
<thead>
<tr>
<th>species</th>
<th>Mean persistence rate per day</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barnacle Goose</td>
<td>0.948</td>
<td>0.944-0.952</td>
</tr>
<tr>
<td>Common Buzzard</td>
<td>0.922</td>
<td>0.916-0.928</td>
</tr>
<tr>
<td>Golden Plover</td>
<td>0.882</td>
<td>0.874-0.890</td>
</tr>
<tr>
<td>Skylark</td>
<td>0.873</td>
<td>0.865-0.882</td>
</tr>
<tr>
<td>Goldcrest</td>
<td>0.871</td>
<td>0.863-0.880</td>
</tr>
</tbody>
</table>
Fatality estimation

we combine

⇒ search efficiency
⇒ daily persistence rate
⇒ number of searches per site
⇒ interval length between 2 searches
⇒ proportion of carcasses inside the search area
⇒ proportion of carcasses outside the search plot
⇒ number of carcasses found (inside the search plot)

and use \textit{pkorner()} and \textit{estimateN()} from R-package \textit{carcass}

\textbf{to estimate the total number of fatalities}
Fatality estimation – species and numbers found

<table>
<thead>
<tr>
<th>species</th>
<th>numbers found</th>
<th>estimated proportion outside search plot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common Buzzard</td>
<td>12</td>
<td>0.14</td>
</tr>
<tr>
<td>Red Kite</td>
<td>3</td>
<td>0.11</td>
</tr>
<tr>
<td>Lapwing</td>
<td>9</td>
<td>0.17</td>
</tr>
<tr>
<td>Golden Plover</td>
<td>5</td>
<td>0.17</td>
</tr>
</tbody>
</table>
Fatality estimates

- Common Buzzard: n=12
- Red Kite: n=3
- Lapwing: n=9
- Golden Plover: n=5

T. Grünkorn CWW Berlin 2015
estimate daily collision rate per wind turbine

Divide estimate by the number of wind turbine days (number of wind turbines * 12 weeks * 7 days)

Common Buzzard  Red Kite  Lapwing  Golden Plover

T. Grünkorn CWW Berlin 2015
Daily collision rate per wind turbine is constant across the year for a resident species present throughout the year, e.g. Common Buzzard.

Multiply the daily collision rate per turbine * 365 days

⇒ estimate of the number of collisions per year and turbine

0.48 Common Buzzard collisions per turbine per year

Estimates of season (spring & autumn) specific daily collision rates per turbine are very similar for the Common Buzzard.
Annual collision rate of Common Buzzards: 
*0.48 (0.27-0.84) fatalities at each turbine per year*

Assuming this is true for every turbine in a given geographical area:

Example Schleswig-Holstein: 
- some 3,200 wind turbines, 
- **1,600 Common Buzzard fatalities in Schleswig-Holstein per year**, 
- estimated number of Common Buzzards (breeding and nonbreeding birds, juveniles, migrants) in Schleswig-Holstein is 25,000 individuals.

**6 % of the population** annually collide with turbines.
• The estimated overall daily collision rates per wind turbine apply to the wind turbines searched and to the time, when these turbines were searched. Extrapolations have to be treated with care.

• Wind farm specific estimates are difficult to obtain, but results are considered as representative for northern Germany.

• Overall daily collision rate per wind turbine for Common Buzzard is considered as robust; for most other species numbers of found fatalities is too low.

• Potential negative effects may occur for some long lived species with low population size (e.g. Common Buzzard), minor effects for species with large population size.
Thank you for your attention

and

Supported by:

Federal Ministry for Economic Affairs and Energy

on the basis of a decision by the German Bundestag