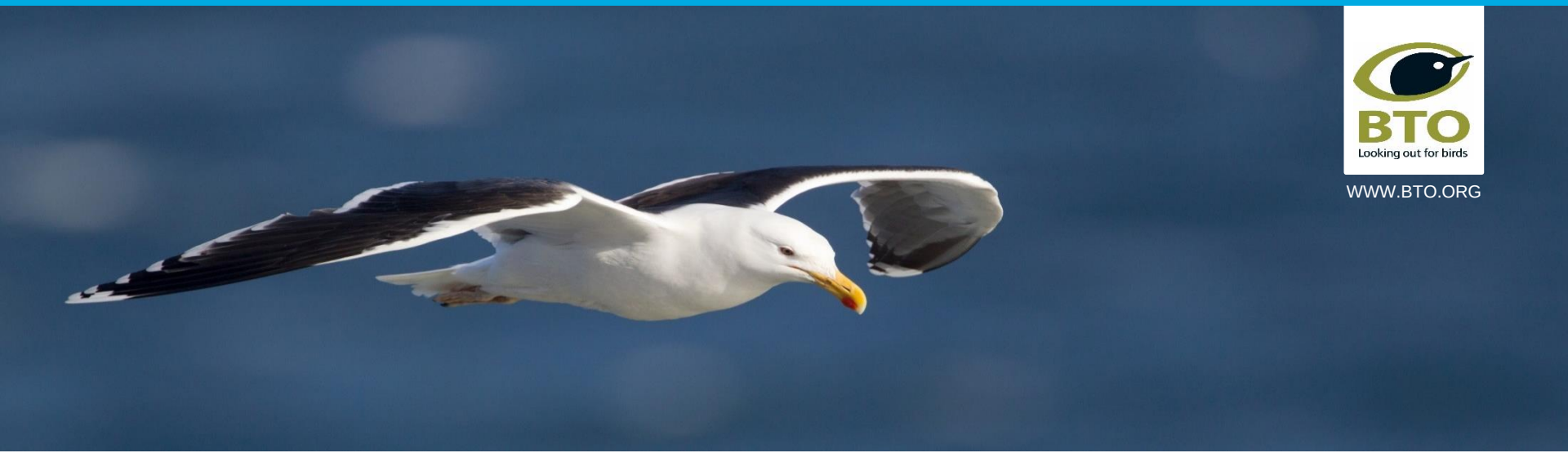


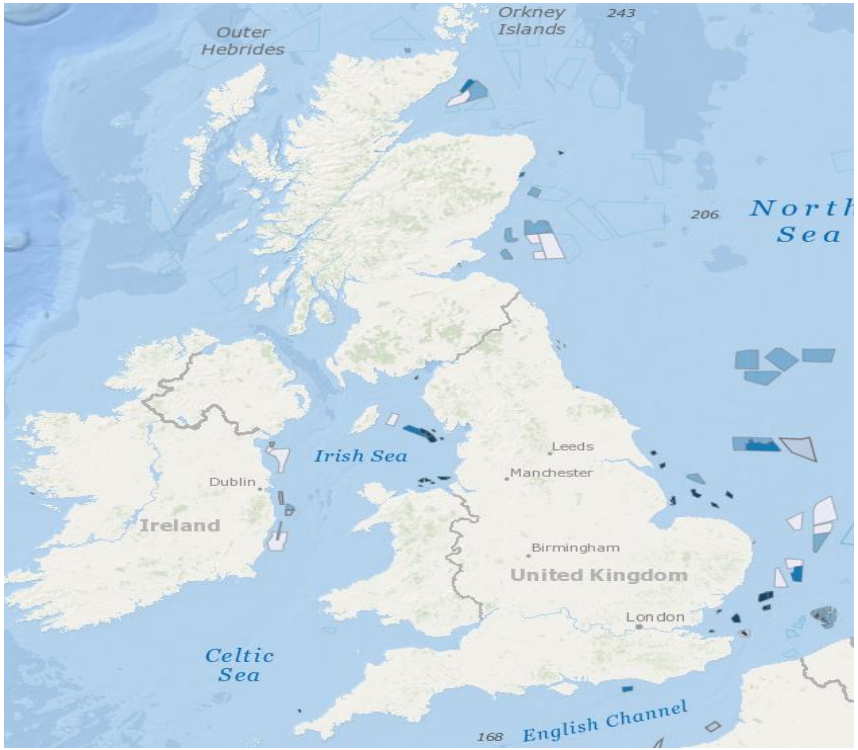
WWW.BTO.ORG

Great Black-backed Gull, by Edmund Fellowes

Cumulative impacts to birds from collisions with offshore wind farms

Dr Aonghais Cook, British Trust for Ornithology

Offshore Wind in the UK



- Key part of government strategy to reduce Carbon emissions
- 1,832 turbines, 33 projects, 7.1GW capacity
- 11.3 TWh generated in 2018
- Up to 34% of UK energy needs
- Target for 40GW installed capacity by 2030

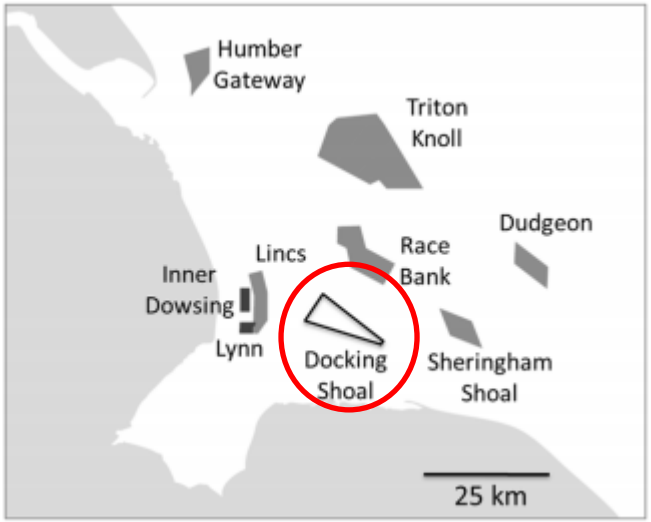
Collisions

- Most high profile negative impact – collisions
- High profile incidents onshore leads to concerns offshore

Everaert, J. 2008. *Effecten van windturbines op de fauna in Vlaanderen*. INBO, Brussel.

Docking Shoal

- 540 MW Offshore Wind Farm with 108 turbines in the Outer Wash Estuary
- First UK Offshore Wind Farm to be refused planning consent
- Considered alongside Race Bank & Dudgeon
- Adverse cumulative effects on breeding Sandwich Terns
- Docking Shoal deemed to have disproportionate impact



Collisions Offshore

- >20 years since first offshore wind farm commissioned
- Despite this, very few records of collisions
  - Fulmar with turbine bases, Blyth
  - Small bird/bat, Denmark
  - 4 Eider, Sweden
  - 5 “large gulls” & 1 kittiwake, Thanet
- Collisions do occur but, hard to detect

Collision Risk Models

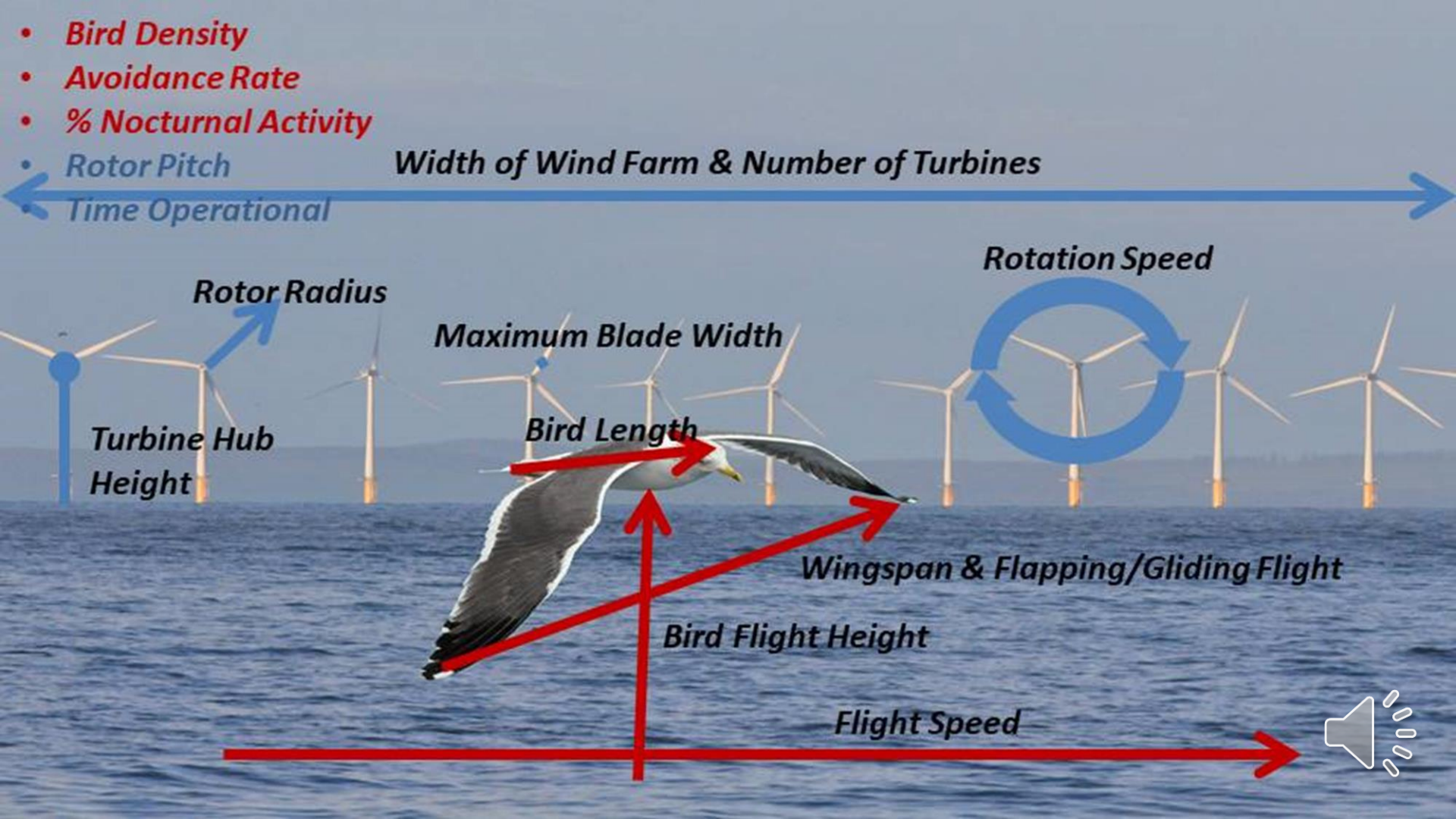
Model name and reference	Includes avoidance behaviour	No. of turbines	Tower included	Wind speed/direction included	Oblique angles of approach	Stochastic	Model output
Band (Band, 2012a, 2012b)	Y	Multiple	N	N	N	N	Number of birds colliding
Tucker (Tucker, 1996a, 1996b)	N	Single	N	N	N	N	Probability of collision
Biosis (Smales et al., 2013)	Y	Multiple	Y	N	Y	N	Number of birds colliding
Podolsky (Podolsky, 2008)	Y	Multiple	Y	N	Y	N	Probability of collision
McAdam (McAdam, 2005)	N	Single	N	Speed & direction	Y	Y	Probability of collision
Desholm (Desholm, 2006)	Y	Multiple	N	Direction	N	Y	Number of birds colliding
Eichhorn (Eichhorn et al., 2012)	Y	Single	N	N	N	Y	Mortality rate
Hamer (Holmstrom et al., 2011)	N	Single	N	Speed & direction	Y	N	Probability of collision
Bolker (Bolker et al., 2014)	N	Multiple	N	N	Y	N	Probability of collision
USFWS (U.S. Fish and Wildlife Service, 2013)	Y	Multiple	Not specified	N	N	Y	Number of birds colliding

Masden & Cook 2016. EIA Review. 56: 43-49

- Assessed pre-construction using Collision Risk Model (CRM)
- Variety of models available
- Most widely used Band model

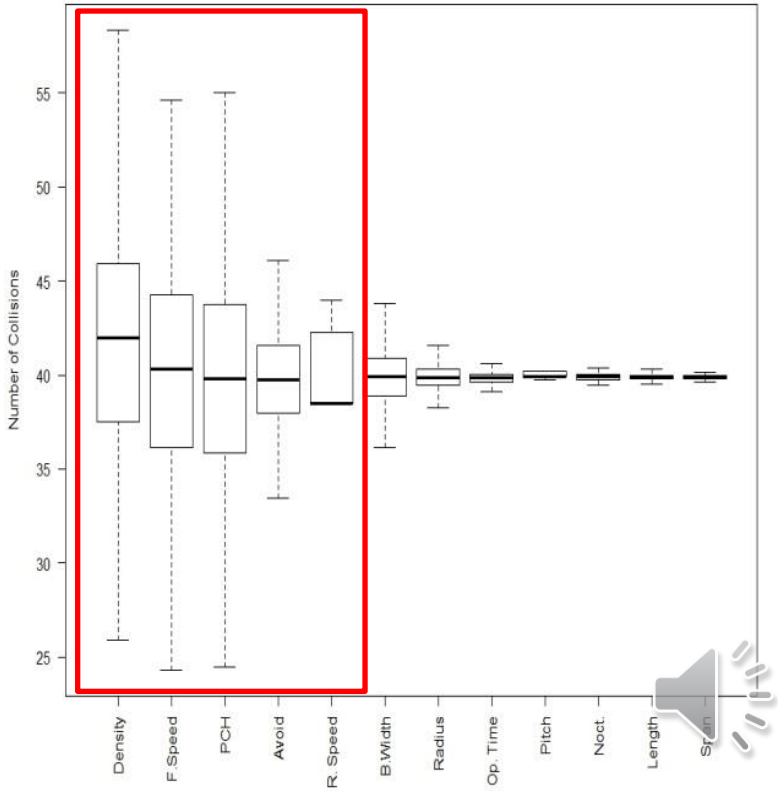
https://dmpstats.shinyapps.io/avian_stochcrm/

- Bird Density
- Avoidance Rate
- % Nocturnal Activity
- Rotor Pitch
- Time Operational



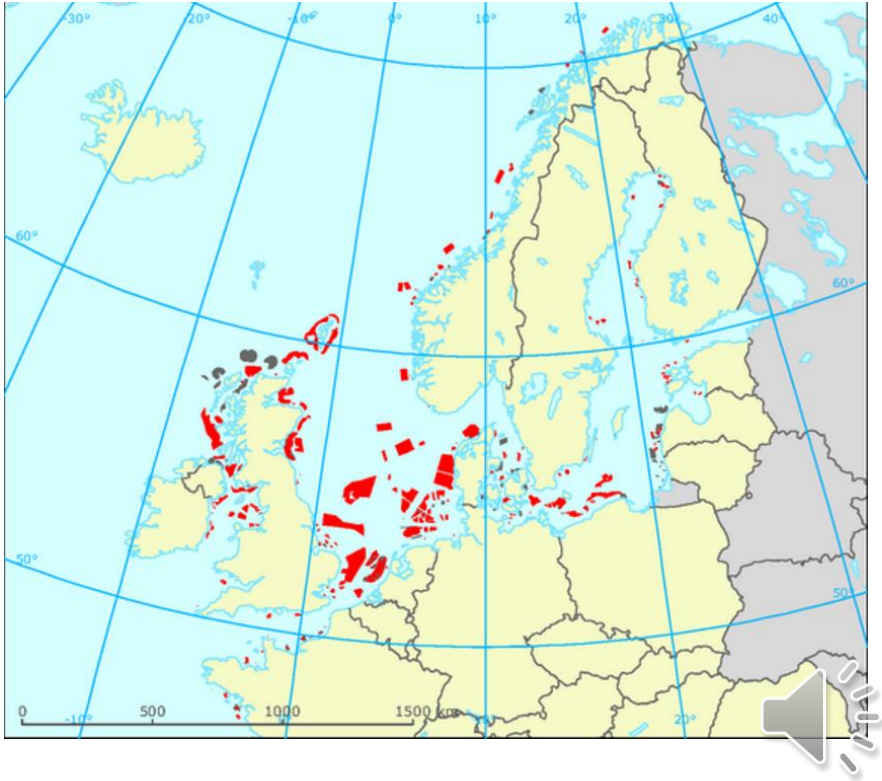
Precautionary Principle

- “Reasonable worst case scenario”
- Model sensitive to a number of input parameters, many of which are stochastic in nature
- Leads to concerns precaution magnified through the process

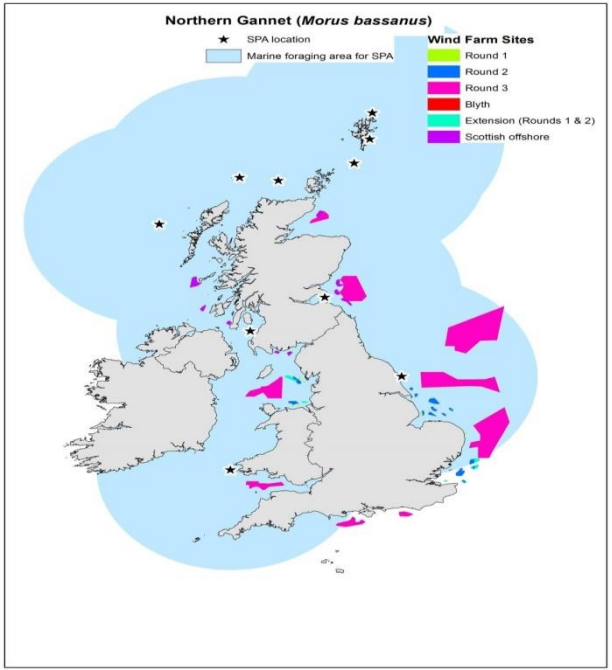


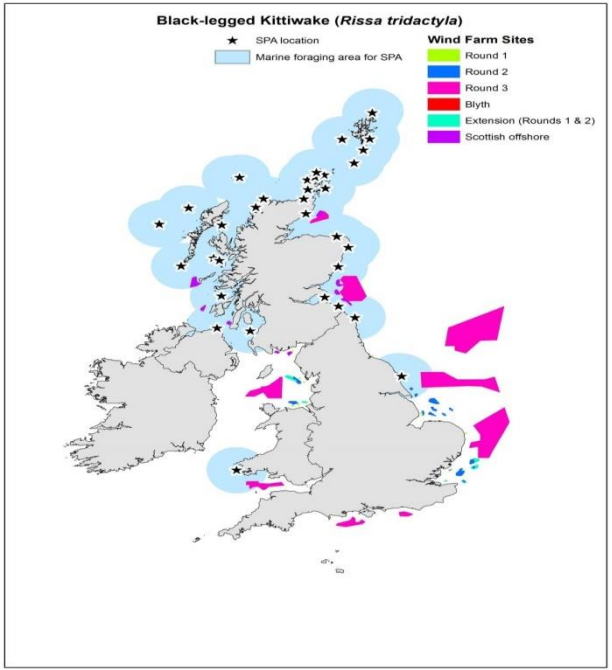
Cumulative Impacts

- Early projects, small scale, nearshore, low risk
- Projects becoming larger, moving further offshore



Cumulative Impacts



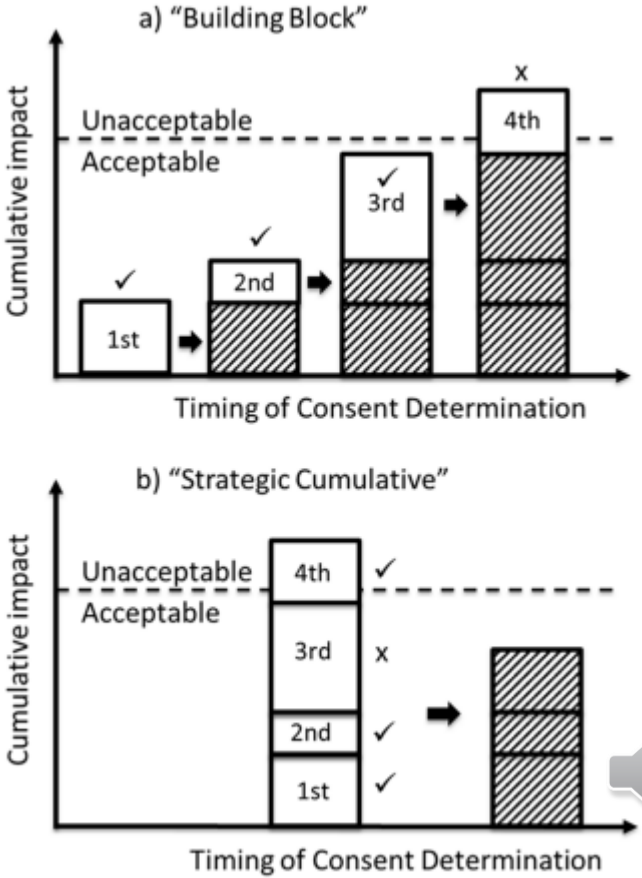


Predicted Collision Rates

- Challenging to estimate cumulative collision rates
  - Different models
  - Refined parameters
- 352 Kittiwake collisions annually at 1 colony (Busch & Garthe 2017)
- ~10 increase in annual mortality for Great & Lesser Black-backed Gulls (Brabant et al. 2015)

Headroom

- Threshold for level of “acceptable” impact
- Particular concern in relation to black-legged kittiwake & northern gannet
- Race to submit assessments & avoid being project that pushes cumulative impact over “acceptable” limit



Broadbent & Nixon (2019) Refusal of planning consent for the Docking Shoal offshore wind farm: Stakeholder perspectives and lessons learned. *Marine Policy*

So, what can we do?

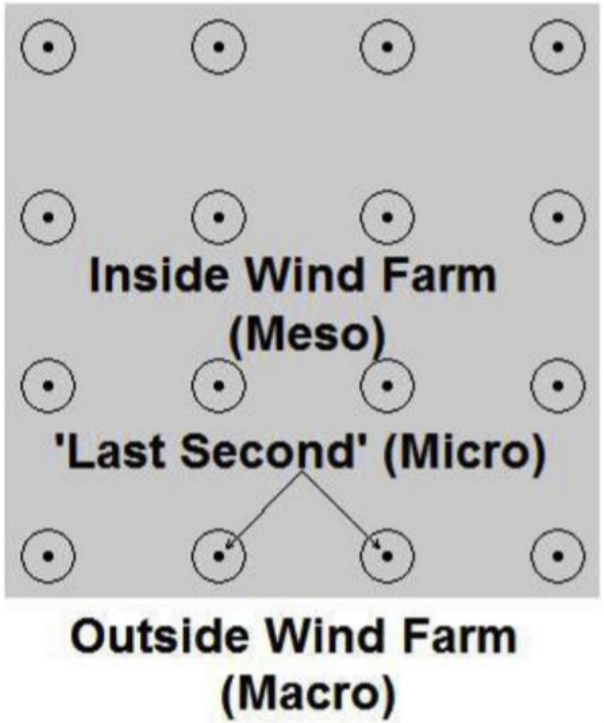
Reduce precaution with better data!

Avoidance

- Occurs at a variety of scales
  - Macro (outside wind farm)
  - Meso (inside, avoids turbines)
  - Micro (“last second”)
- Often calculated as:

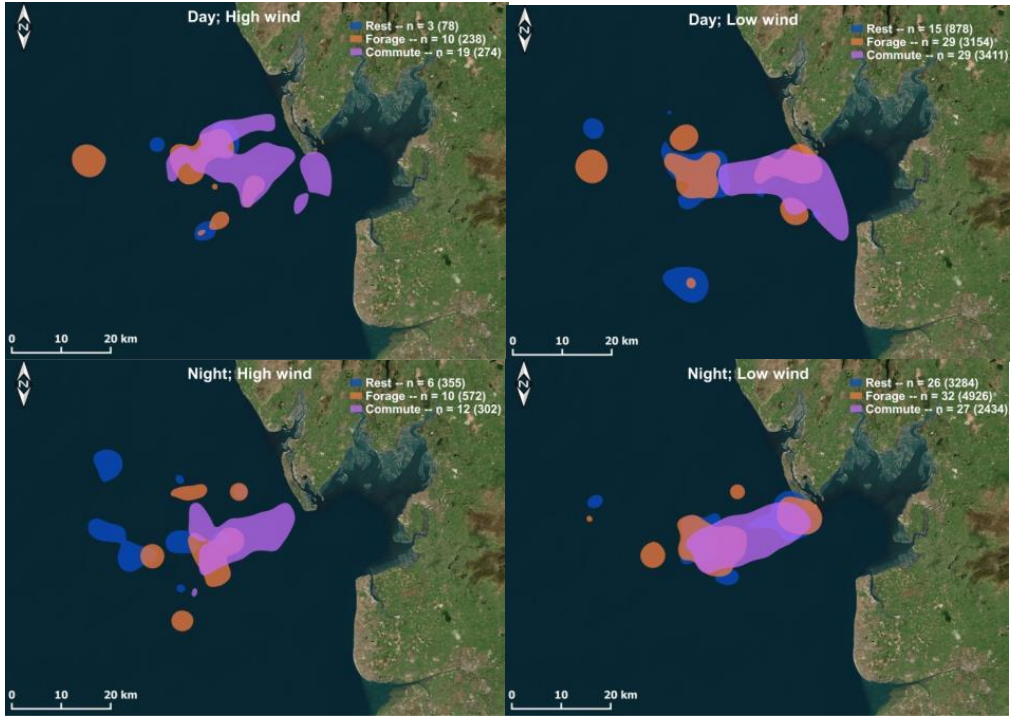
$$Avoidance = 1 - \left(\frac{Observed\ Collision\ Rate}{Predicted\ Collision\ Rate}\right)$$

- Avoidance rate increased from 0.98 to 0.995 for some species, reducing predicted collisions by >50%



Cook et al. 2018. Marine Environmental Research 140 278-288

Behaviour

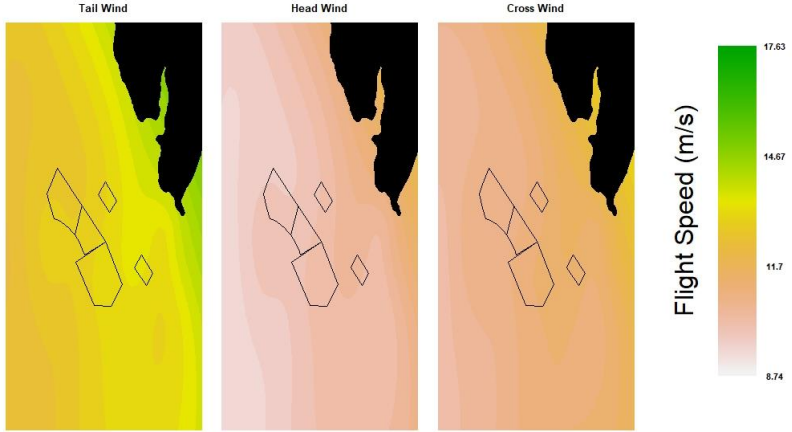


- Lesser Black-backed Gull, Walney
- GPS tracking data, HMM analysis
- Spatial patterns in behaviour linked to time of day & wind conditions
- How does this influence collision risk?

Thaxter et al. 2019. Report to Marine Scotland Science

Flight Speed

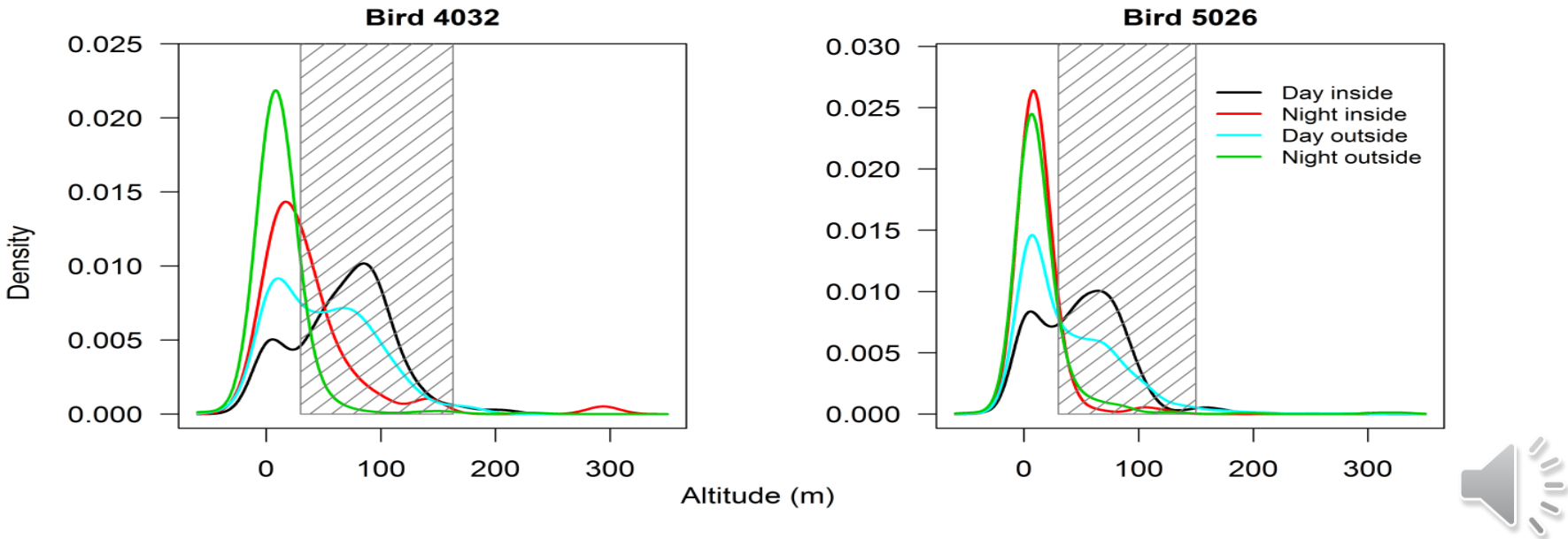
- Recommended speed of 13.1 m/s from Alerstam et al. (2007)
- Using speed recorded using GPS tags & accounting for location & wind speed results in reduced collision estimate



Wind Farm	Collisions (actual)	Collisions (Alerstam)	% Increase
Barrow	14.21	15.51	9.1
Ormonde	0.91	1.04	15
Walney 1	2.67	3.18	16.1
Walney 2	3.02	3.63	18.9
West of Duddon Sands	6.89	8	20.2
TOTAL	27.7	31.39	13.2

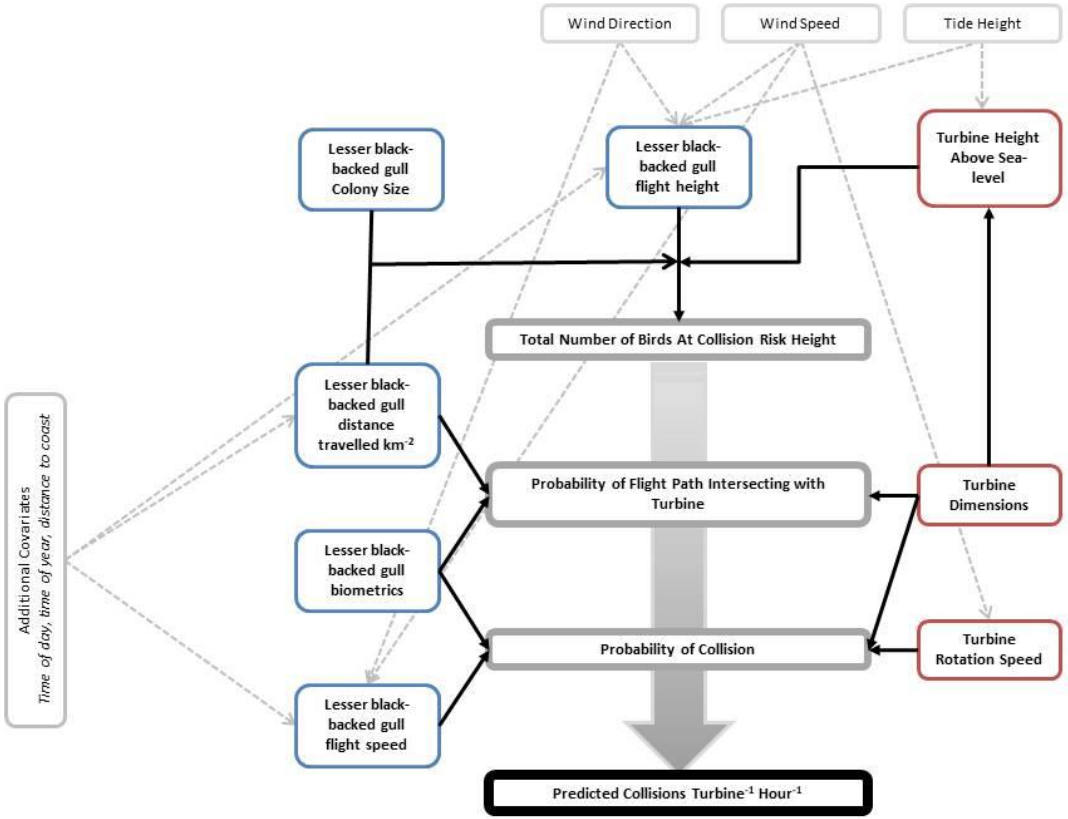
Flight Heights

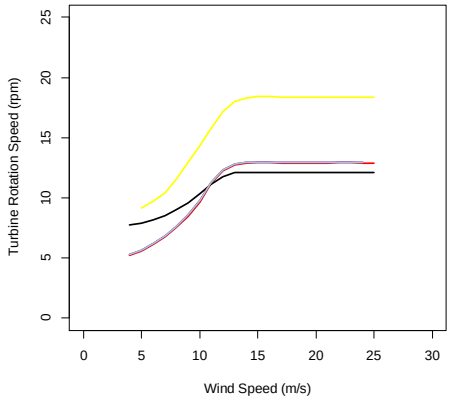
- Flight heights greater in day
- Flight heights in day differ inside and outside wind farms

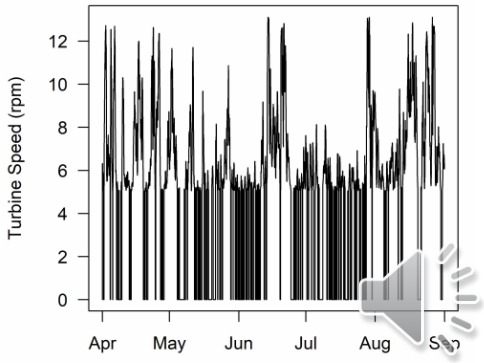


Thaxter *et al.* (2018) *MEPS* 587: 247-253

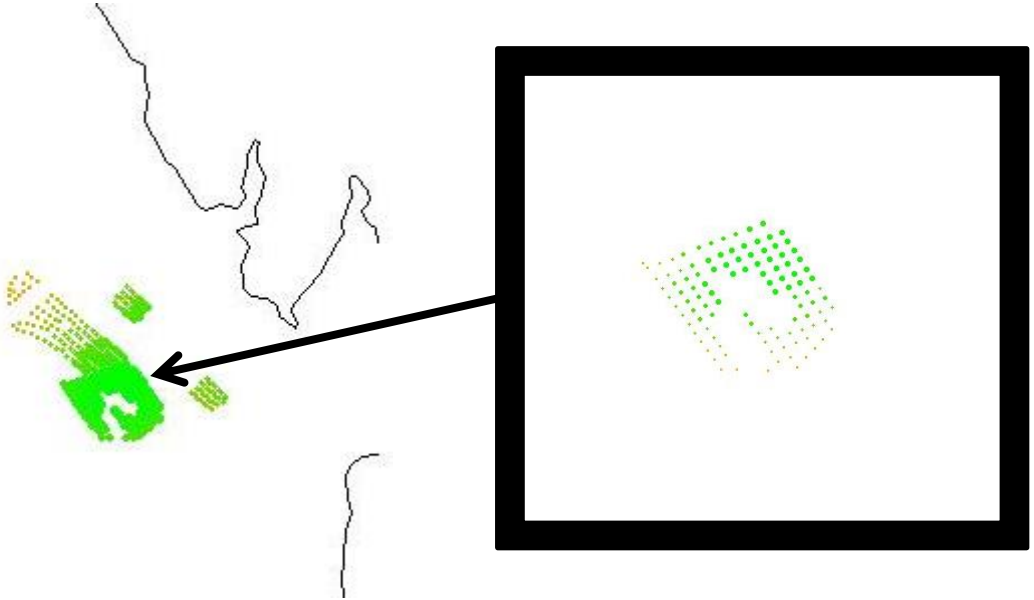
Using GPS data to estimate Collision Risk

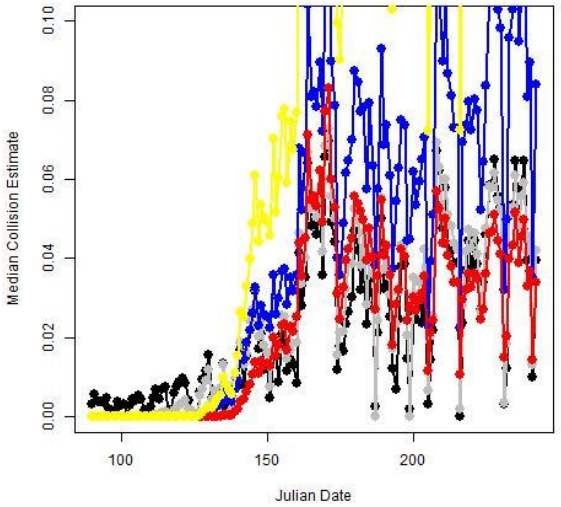






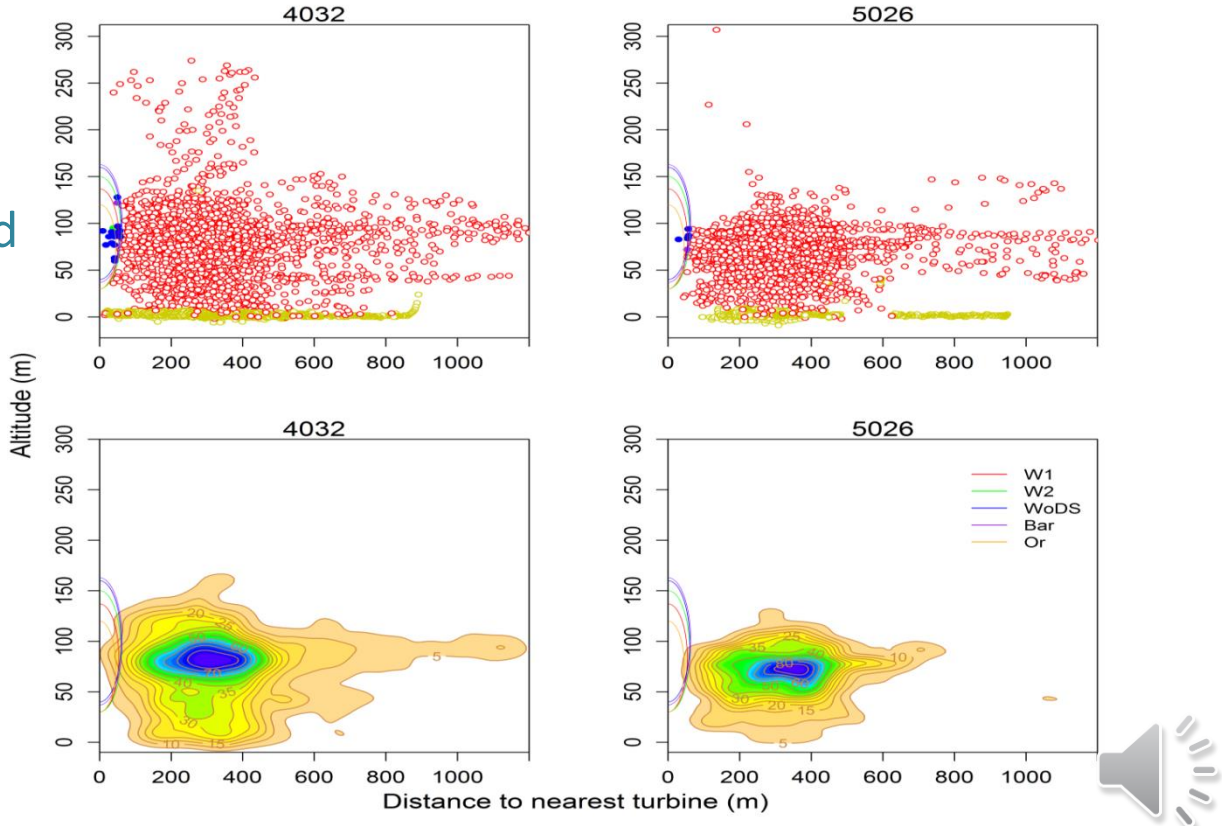
Using GPS data to estimate Collision Risk





Measure Collisions/Avoidance

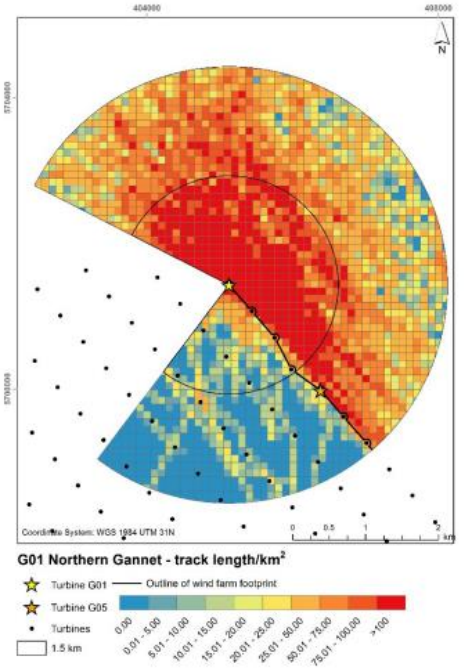
- GPS tagged Lesser Black-backed Gulls
- Distance to turbine and flight altitude
- Very little overlap with the rotor sweep zone
- Do lesser black-backed gulls show avoidance within but not of wind farms?



Thaxter *et al.* (2018) *MEPS* 587: 247-253

Measure Collisions/Avoidance

- Combined camera-radar system mounted on Turbines
- Thanet OWF, UK – current studies underway at Aberdeen Bay (UK) & Luchterduinen (NL)
- Records proportion of birds responding to turbines
- 6+ collisions detected
  - Avoidance behaviour? YES
  - Avoidance RATES? NO!
- Avoidance rates for CRM incorporate model error (estimated at ~20% in Band 2012)



Summary

- Few records of collision offshore
- Rely on pre-construction collision risk models
- CRMs very sensitive to input parameters & uncertainty means many of these are precautionary
- As a consequence, cumulative impact of collisions putting future development of offshore wind in Europe at risk
- By collecting better data, we can reduce this precaution and, consequently, the associated consenting risk

Acknowledgements

Thanks for your attention

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