

Study methods for estimating displacement, barrier and habitat effects

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Bird and Bat Research Framework Workshop

Building Energy Exchange, Manhattan, New York March 4-5, 2020

Introduction

- Effects for measurement for offshore installations:
 - Collision
 - Displacement (macro-avoidance)
 - Barriers (to movement)
 - Habitat change
- Legal instruments in Europe for bird protection habitats focussed (EU Birds Directive and EU Habitats Directive)
 - Different flavours of regulations in each EU country
 - Focus for site characterization and monitoring at offshore wind developments
 - Framework of methods built for assessing impacts of developments
 - Precautionary Principle applies

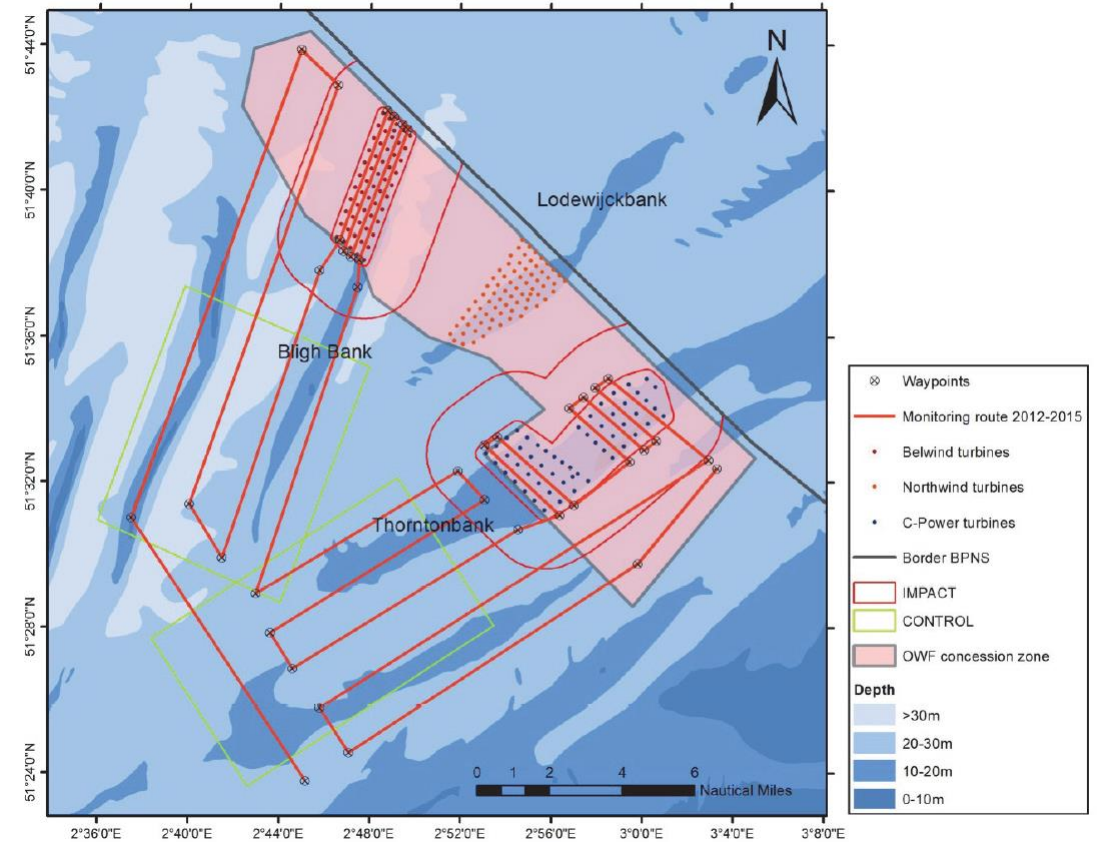


Effects monitoring

- Measurement of effects at post-consent monitoring stage for feeding back to improve estimates of impacts at consenting stage
- In most countries, resources directed at likely significant effects (e.g. less emphasis on barrier effects for long-distance migrants nor habitats effects)
- Effects measurements cross-over into all four key impacts (e.g. 3D displacement used in collision risk modelling, barrier and displacement effects can be measured at same time)
- Hypothesis testing approach

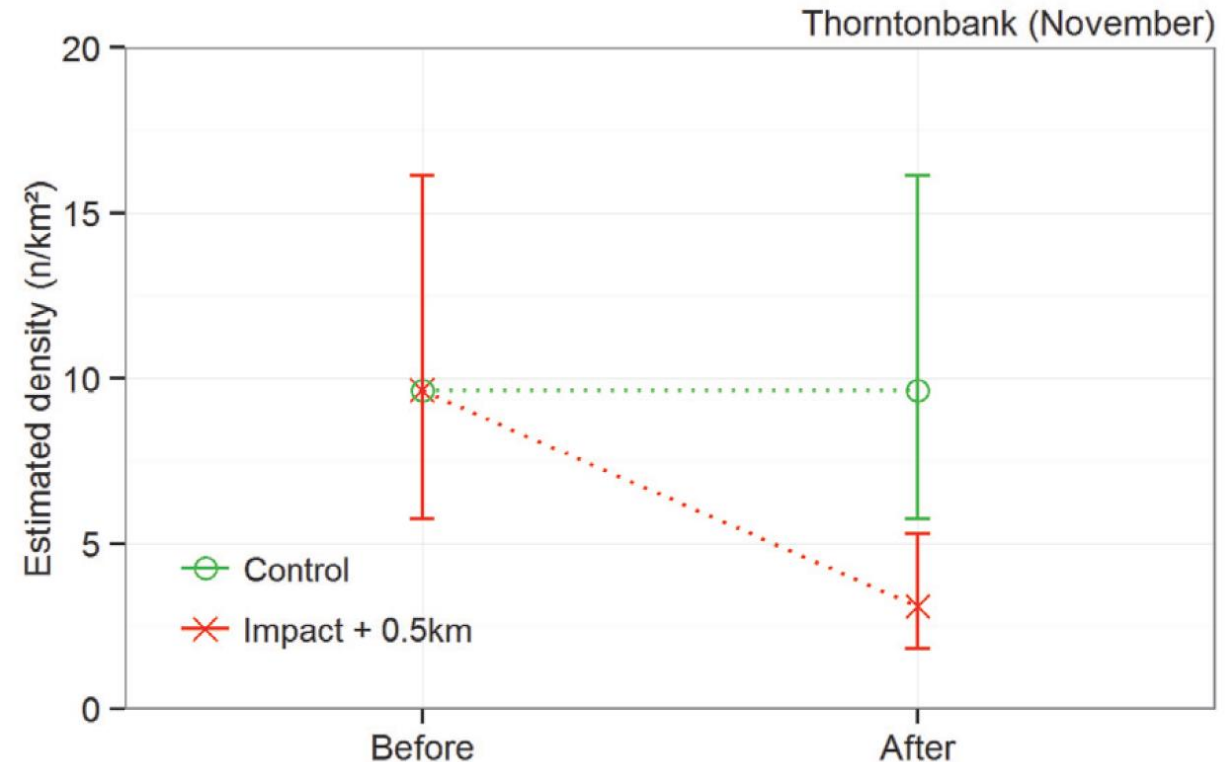
Displacement – population level

- Early studies: Before-After-Control-Impact (BACI)



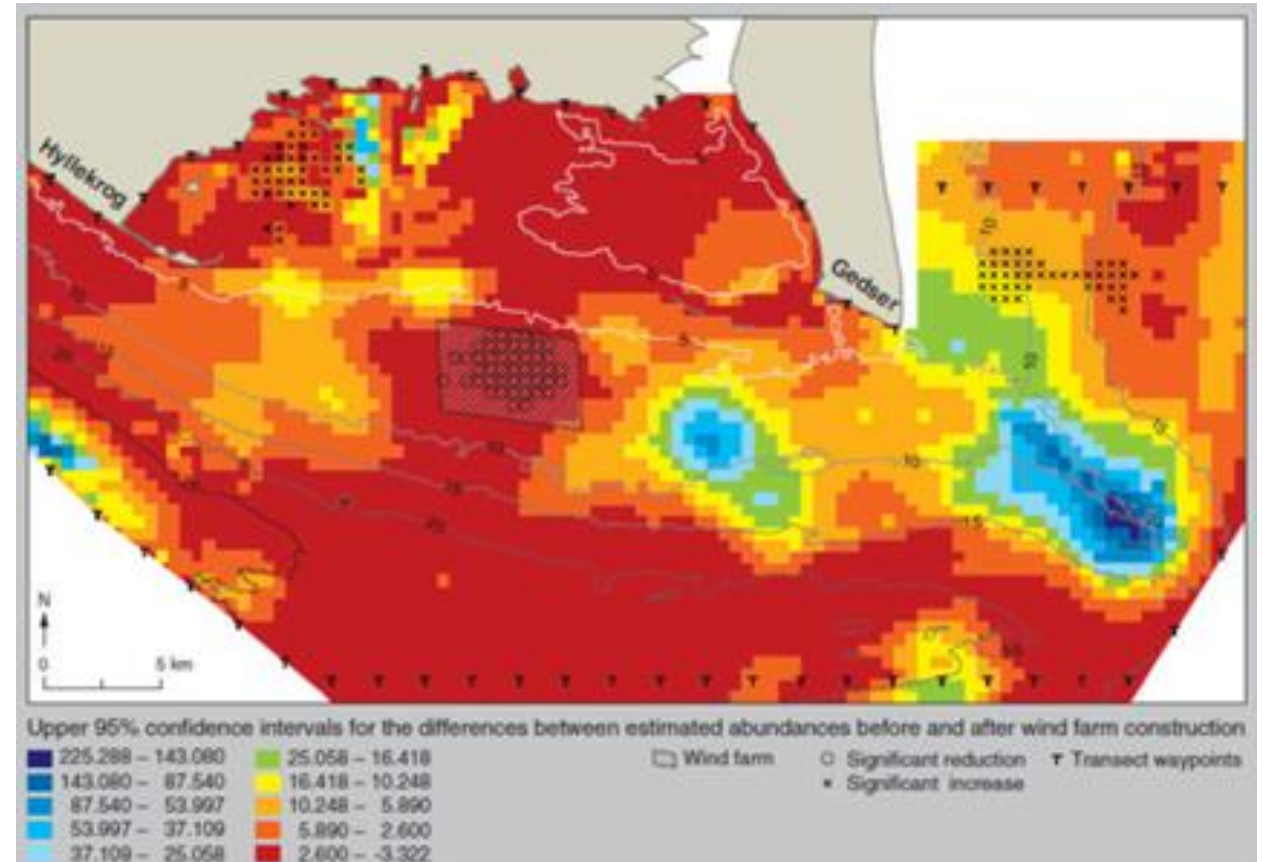
Displacement – population level

- Early studies: Before-After-Control-Impact (BACI)
- Largely insensitive to changes (poor power to detect change, how representative is the control site) and many inconclusive studies



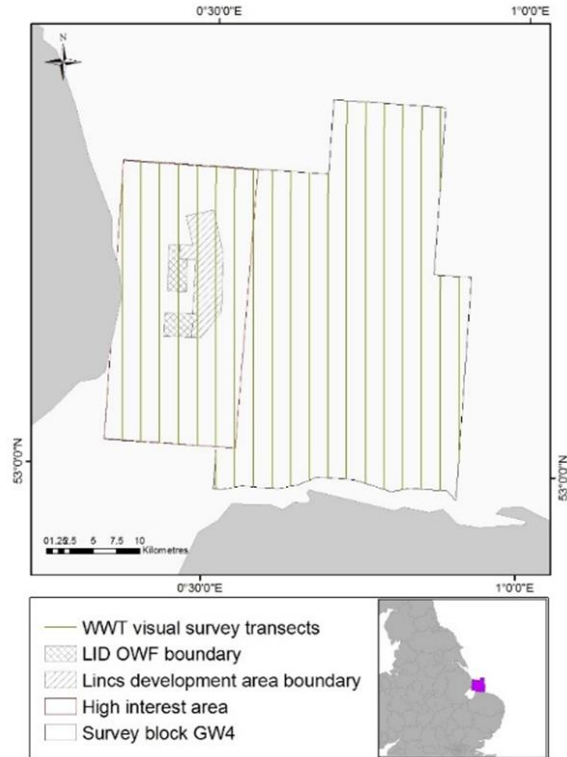
Displacement – population level

- Early studies: Before-After-Control-Impact (BACI)
- Largely insensitive to changes (poor power to detect change, how representative is the control site) and many inconclusive studies
- Moved almost entirely to spatially explicit modelling now (Before-After-Gradient – BAG studies) e.g. pioneering work at Nysted Wind Farm



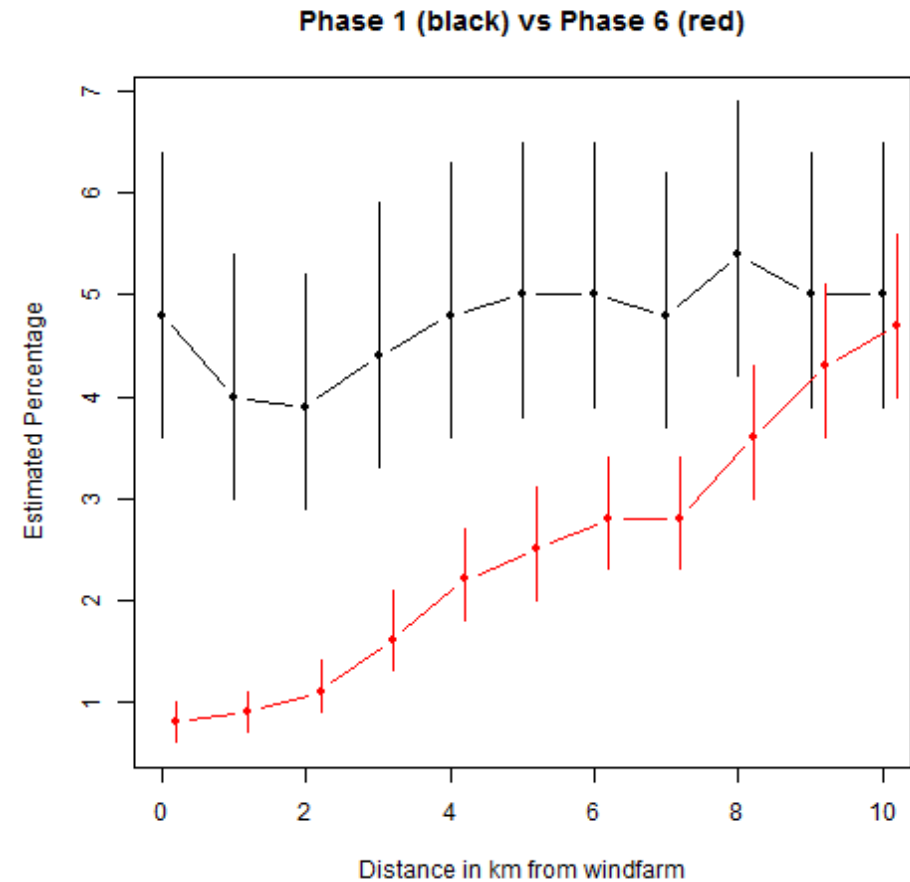
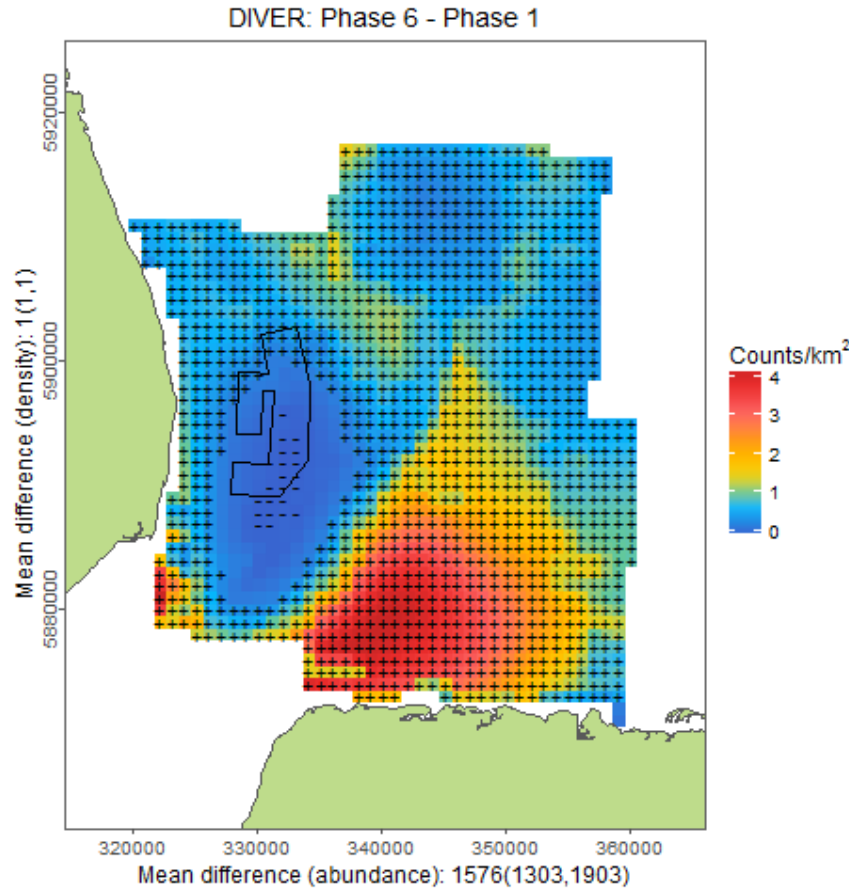
Displacement – population level

Pre-construction
survey design



Post-construction
survey design

Displacement – population level

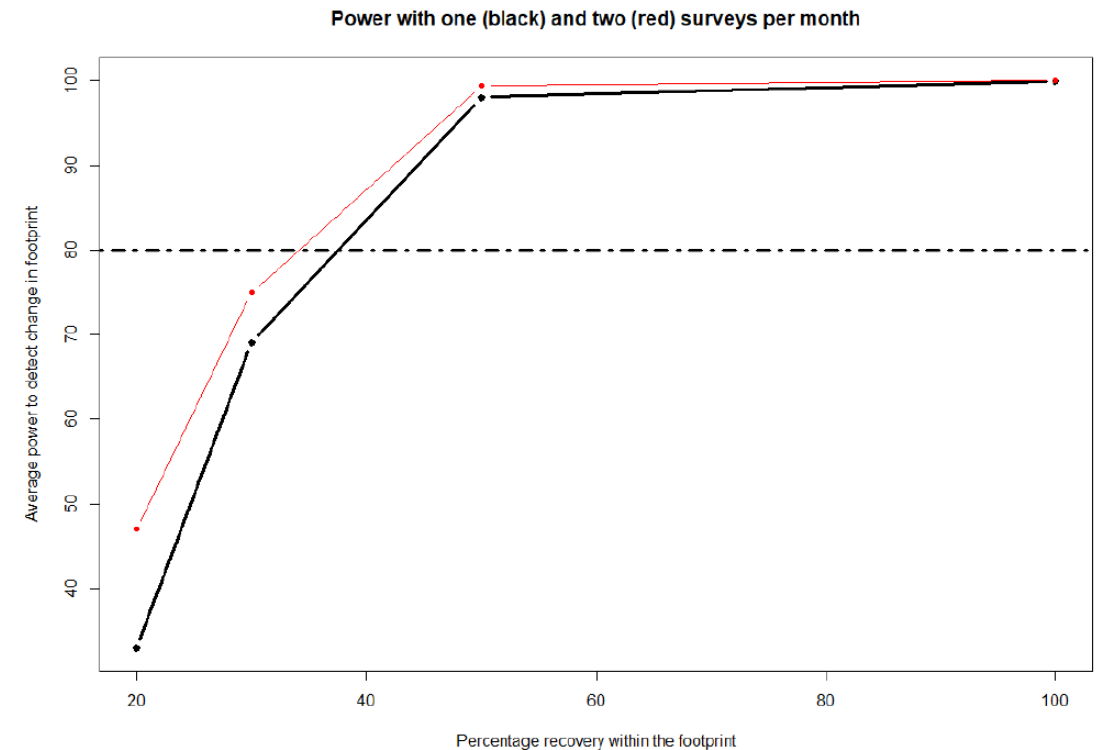


Mackenzie et al. 2013. Statistical Modelling of Seabird and Cetacean data: Guidance Document. University of St. Andrews contract for Marine Scotland; SB9 (CR/2012/05). <https://www2.gov.scot/Topics/marine/marineenergy/Research/SB9>

Webb et al. 2017. Lincs Wind Farm, Third annual post-construction aerial ornithological monitoring report; CREL REF: LN-E-EV-013-0006-400013-007. <https://www.marinedataexchange.co.uk/itemdetails.aspx?id=7022>

Displacement - population

- Survey design important for these approaches:
 - Spatially-explicit modelling flexible with respect to survey design (transect location and orientation)
 - Must sample same spatial extent
 - Wide-scale for displacement from wind farm and where displaced to
 - Cannot simply compare bird density (inter-phase variation)
 - Power analysis important tool



Displacement – population level

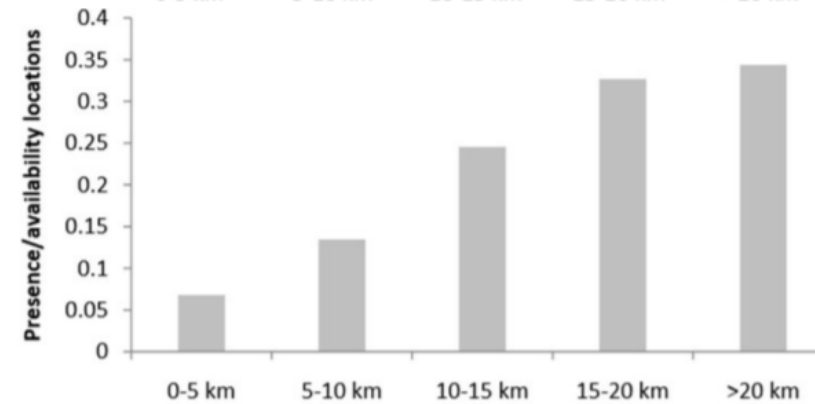
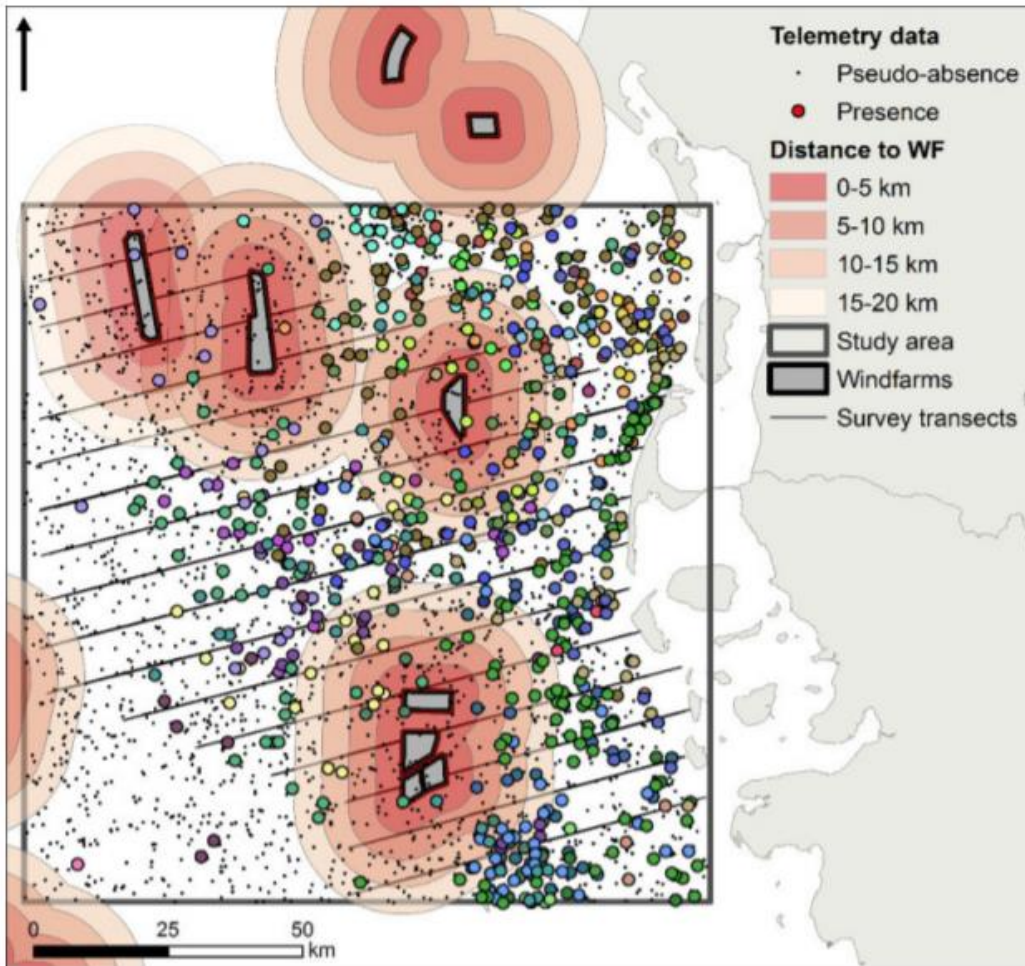
- Other methods:
 - Bayesian Point Pattern Analysis method (R-INLA, INLABRU)
 - Turbine-scale displacement – simulation of actual distance of Alcids from randomised turbine grid location (0 – 500m) differs from displacement distance could occur by chance

Leopold M.F., 2018. Common Guillemots and offshore wind farms: an ecological discussion of statistical analyses conducted by Alain Zuur (WOZEP Birds-1). Wageningen, Wageningen Marine Research (University & Research centre), Wageningen Marine Research report C093/18.

Vilela et al 2019. Assessing the effect of windfarms on marine mammals using point pattern analysis. Poster. http://www.bioconsult-sh.de/site/assets/files/1808/poster_wmmc19_vilela_r.pdf

Trinder 2016. Beatrice Offshore Wind Farm Pre-construction Aerial Survey Report. LF000005-REP-690 <https://www2.gov.scot/Resource/0050/00501847.pdf>

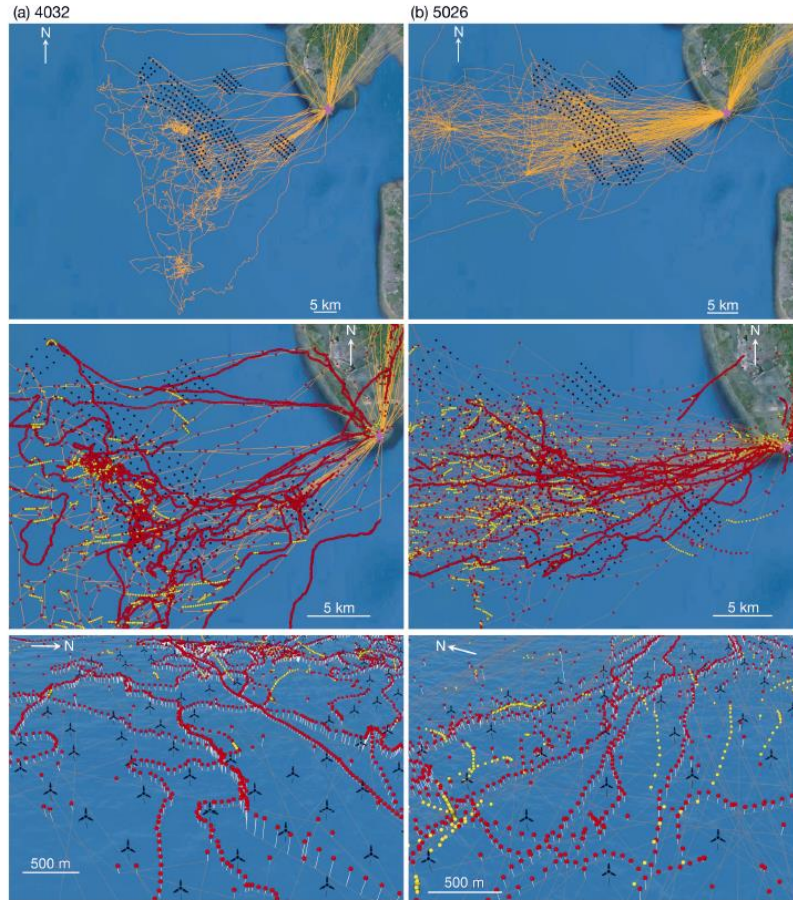
Displacement – individual models



Satellite tagging of
wintering red-
throated loons in
North Sea

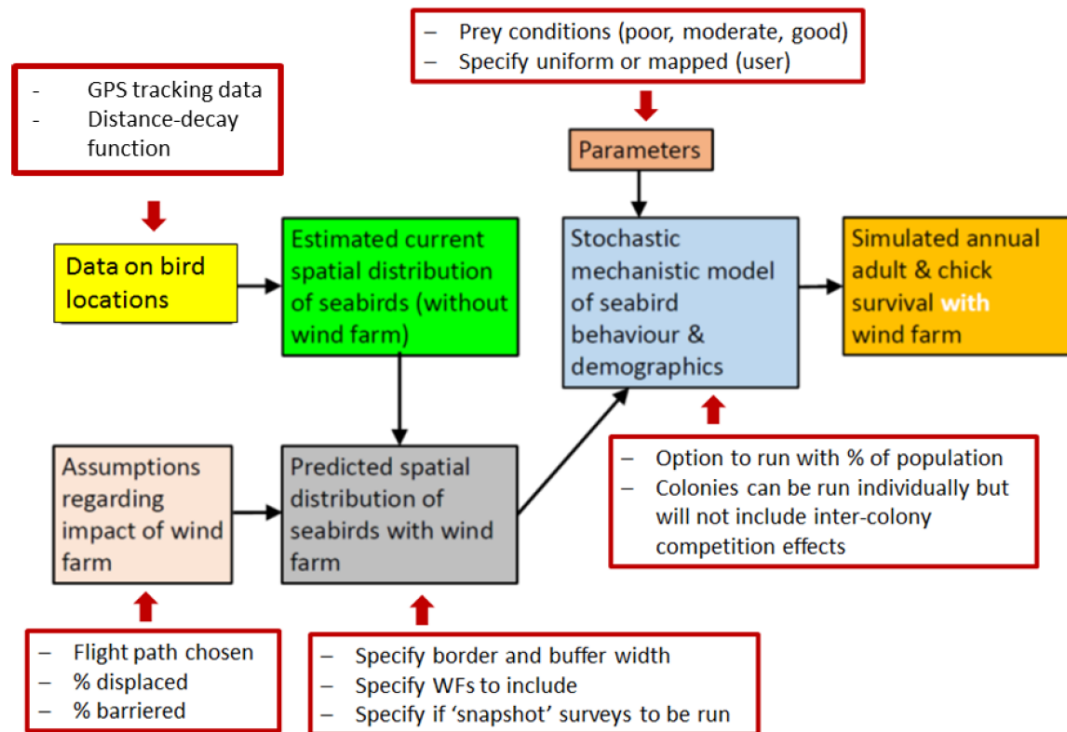


Displacement – individual models



- GPS tagging study (recording position, speed and altitude)
- Breeding adult lesser black-backed gulls – displacement for central-place foragers

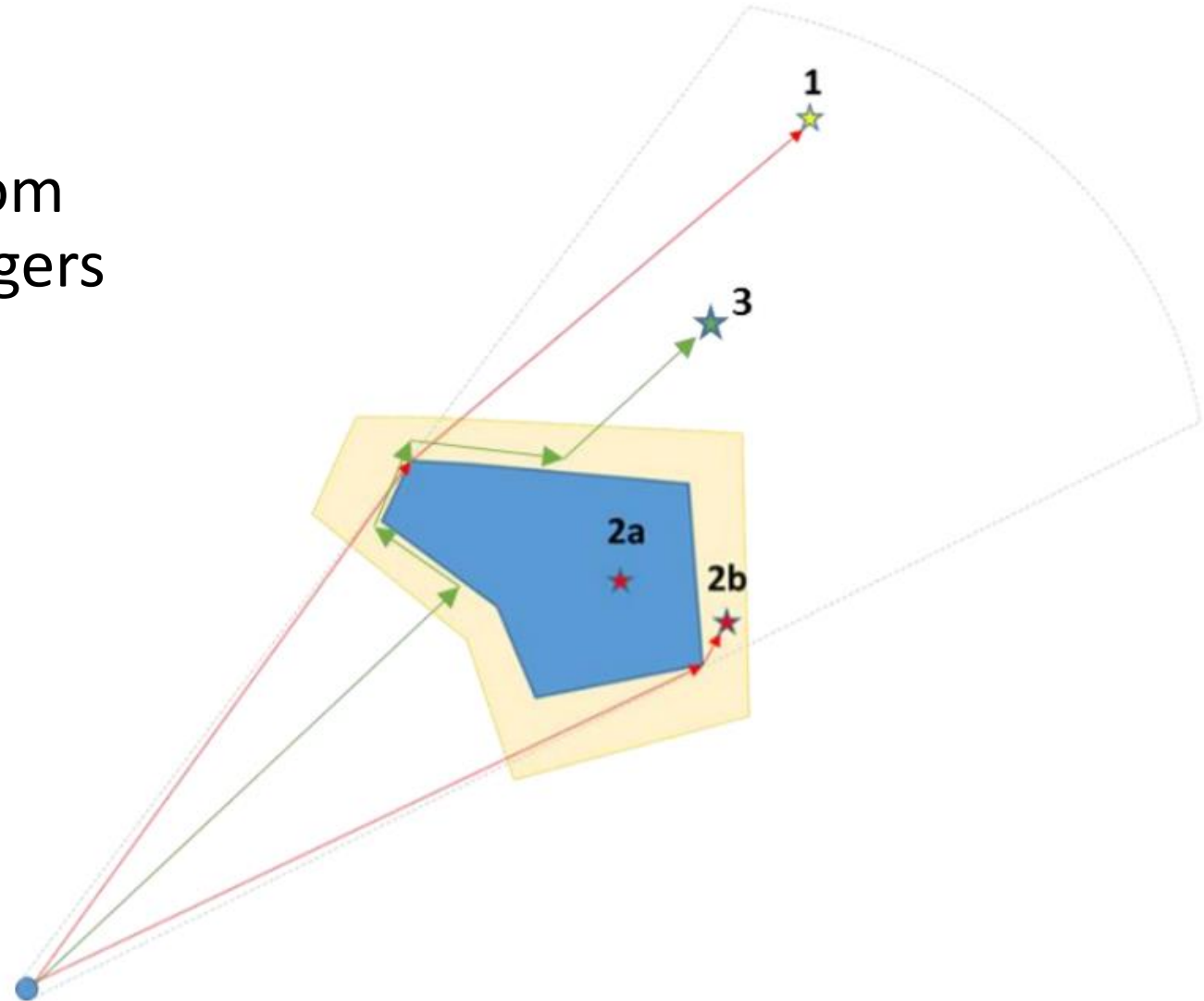
Displacement – SeaBORD



- Simulation model for daily individual time-energy budgets using a number of predicted inputs e.g. prey parameters, % displacement rate, buffer rate, individual colony data, species
- Key output is prediction of adult and chick survival rates and thus prediction of population-scale impacts on species at colony which can be validated with colony studies

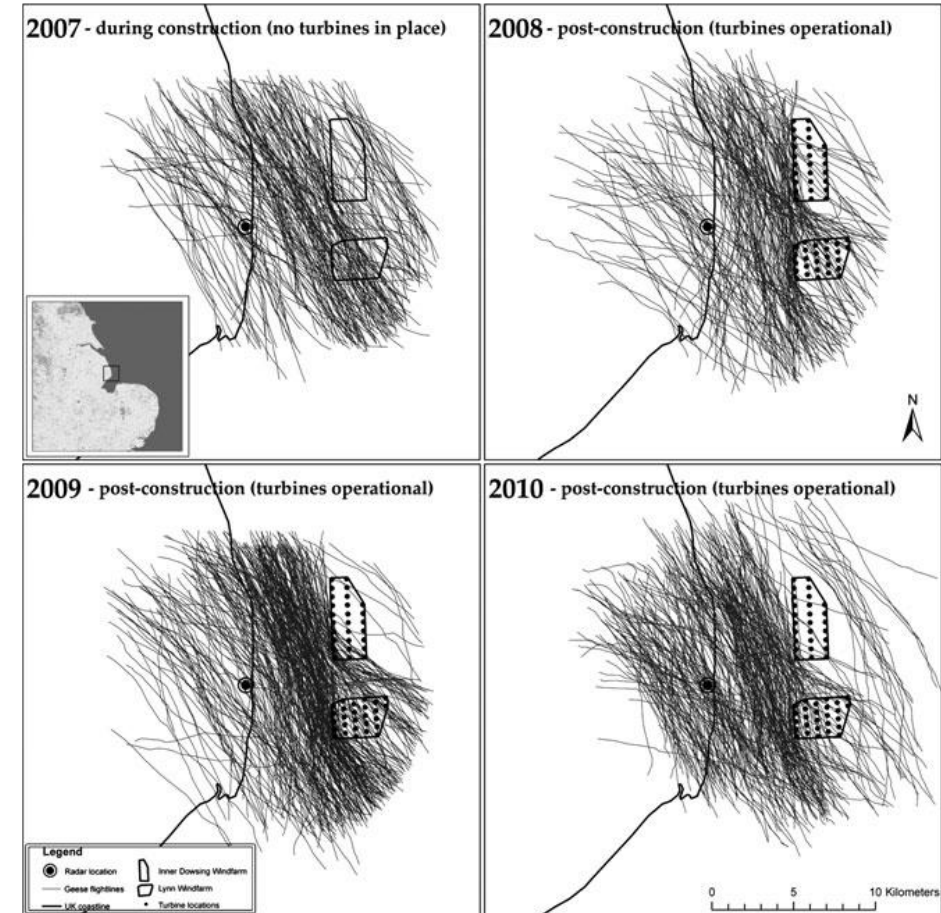
Barrier effects

- Barriers to foraging areas from colony for central point foragers



Barrier effects

- Barriers for feeding movements (e.g. from roost sites)
- Barriers for long distance migrants



Habitat modification effects

- Poor understanding – received little attention in UK so far owing to lack of attention to prey sampling, even at qualitative level
- Fish sampling notoriously difficult
- Modification of benthos most likely at scale of individual turbines
- Modification of current profiles (and circulation in water column) at scale of individual WTG and at wind farm scale
- Offers potential of benefits for birds through modification of human pressures and reef effects

Conclusions and summary

- Monitoring of displacement, barrier and habitat effects are being carried out in Europe, with emphasis on displacement
- Move away from using boats to digital aerial methods for population-level monitoring of distribution change
- Using GPS and satellite tracking for individual-level monitoring, often in combination. With digital aerial survey
- Barrier effects monitoring less well developed, mostly using radar, but GPS tracking can provide information for central place foragers
- More could be done to monitor habitat changes at wind farms