ASSESSING THE EFFECT OF WINDFARMS ON MARINE MAMMALS USING POINT PATTERN ANALYSIS

Raul Vilela[1], Fabian Bachl[1,2], Ansgar Diederichs[1]

[1]BioConsult SH GmbH & Co. KG ; [2]University of Edinburgh

CONCLUSIONS

- NO SIGNIFICANT EFFECTS ON MARINE MAMMALS WERE OBSERVED AT ANY DISTANCE FROM THE OPERATIONAL WINDFARM DURING THE 4-YEAR STUDY PERIOD
- THE INLA-SPDE APPROACH OFFERS AN APPROPIATED METHOD TO MODEL AERIAL SURVEY DATA

INTRODUCTION

- IN THE NORTH SEA, THE LONG TERM EFFECTS OF OPERATIONAL OFFSHORE WINDFARMS ON MARINE MAMMALS DISTRIBUTION REMAIN UNCLEAR[1,2,3]

- PREVIOUS APPROACHES FOR POTENTIAL WINDFARM EFFECTS WERE MORE FOCUSED ON BEFORE-AFTER COMPARISONS WITHOUT CONSIDERING THE SPATIAL AND TEMPORAL DYNAMICS OF THE DATA

- WE APPLY A SPATIAL EXPLICIT POINT PATTERN ANALYSIS APPROACH WITHIN A BAYESIAN FRAMEWORK TO OVERCOME STATISICAL COMMON ISSUES DEALING WITH THIS TYPE OF DATA[4,5] (I.E. SPATIAL STRUCTURE, EXCESS OF ZEROS…)

METHODS

DATA: SERIES OF 35 AERIAL SURVEYS PERFORMED BETWEEN 2015 AND 2018 DURING DIFFERENT SEASONS COVERING AN AREA OF 2750 KM^2

SAMPLING METHOD: HIDEF METHOD[6] (2 CM RESOLUTION VIDEO, LAND BASED IMAGE ANALYSIS AND QUALITY ASSESSMENT)

STUDY AREA: BUTENDIEK OFFSHORE WINDFARM. GERMAN NORTH SEA. NO INTERFERENCE FROM NEAR WINDFARMS

STATISTICAL METHODS: WE APPLIED A POINT PATTERN ANALYSIS USING AN INLA-SPDE APPROACH [4,5]

DISTANCE TO THE WINDFARM WAS INCLUDED IN THE MODEL AS A SPATIAL RANDOM EFFECT

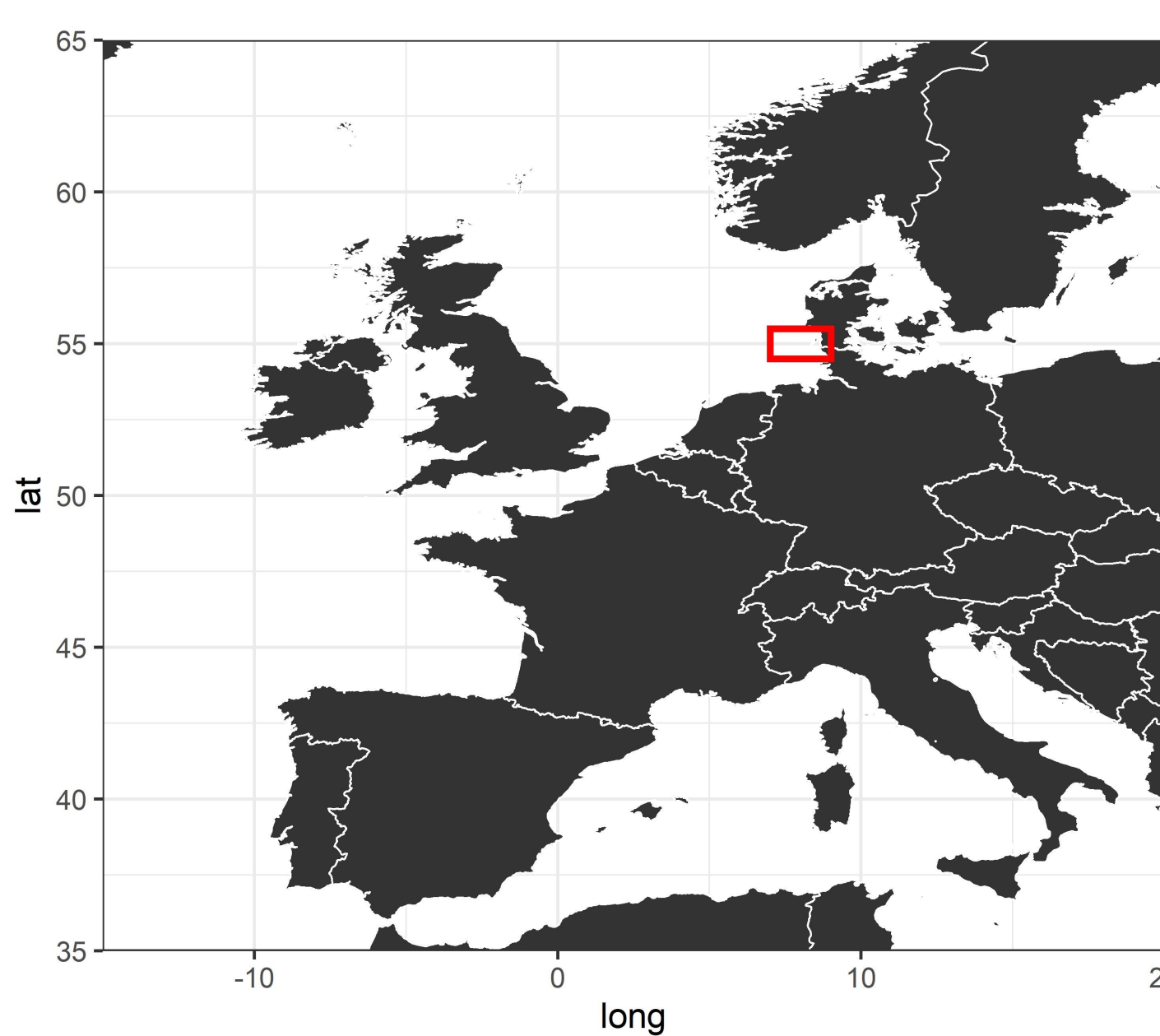ANALYSIS WERE PERFROMED IN R-SOFTWARE[7] USING THE LIBRARY INLABRU[8]
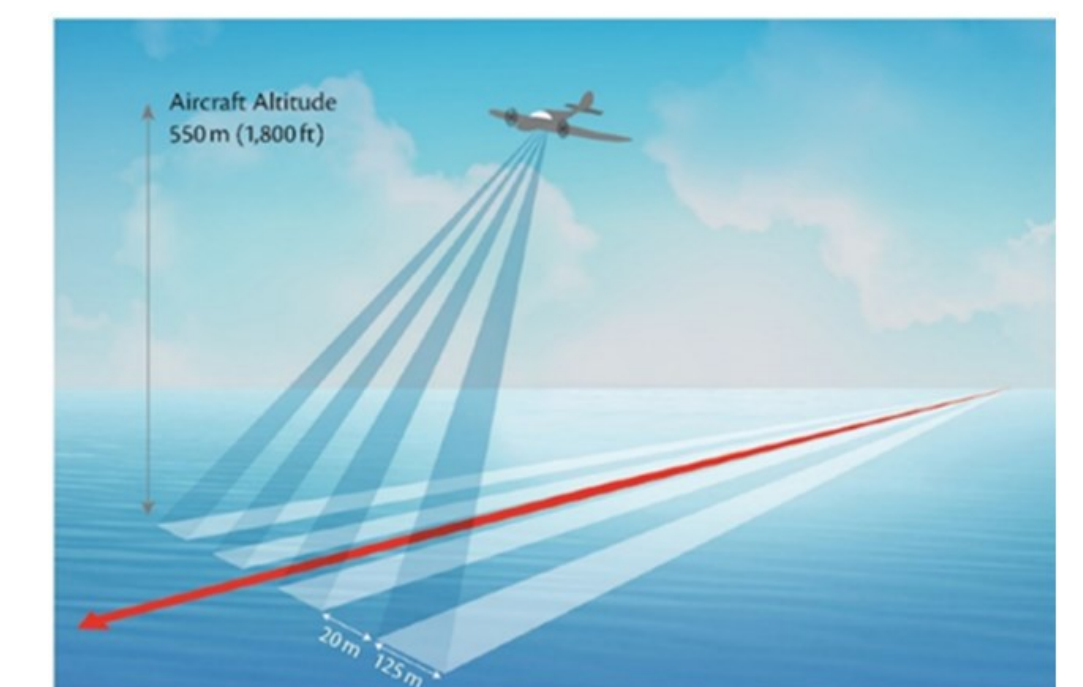
HiDef method uses 4 high resolution videocameras to cover a strip of 544 meters

RESULTS

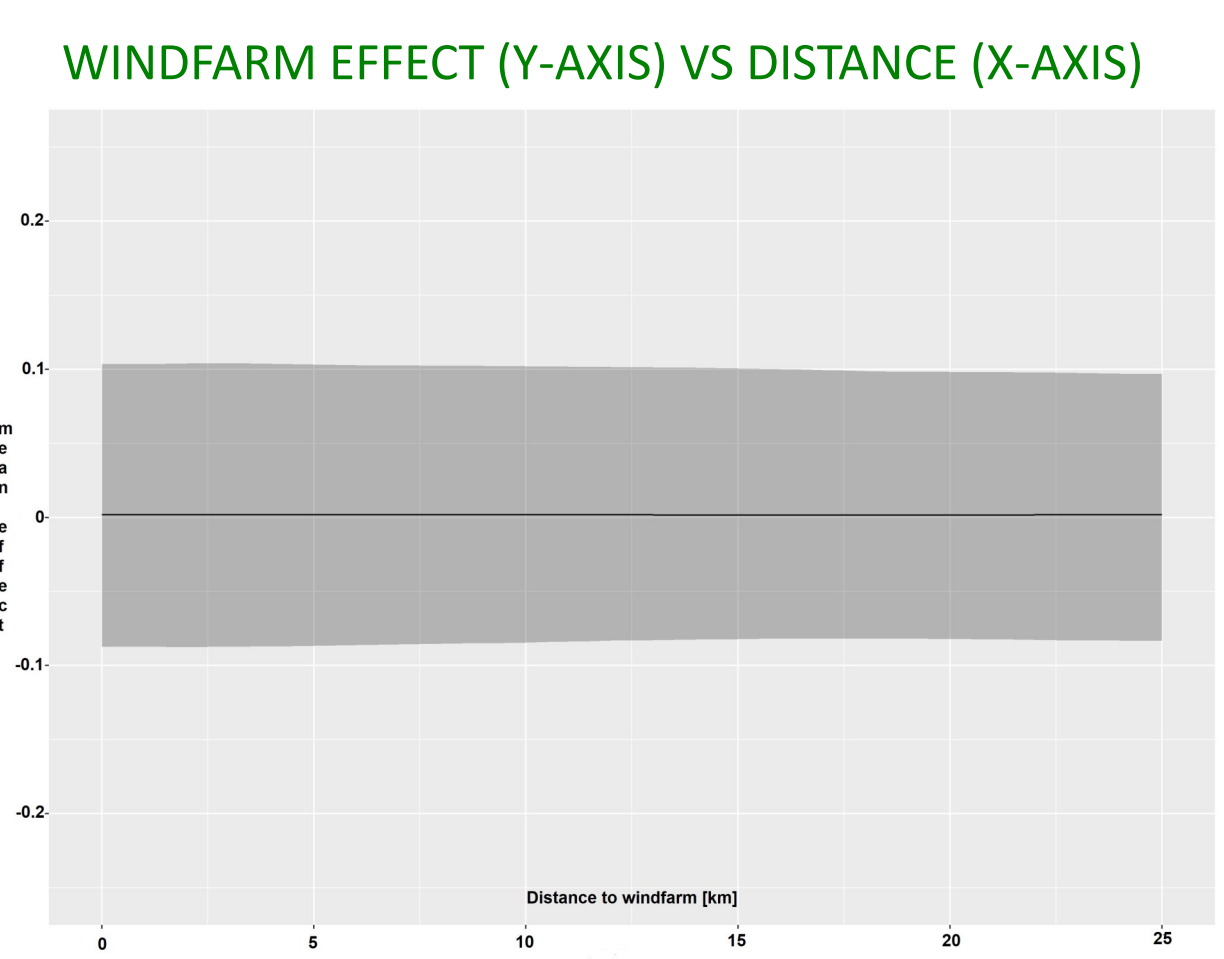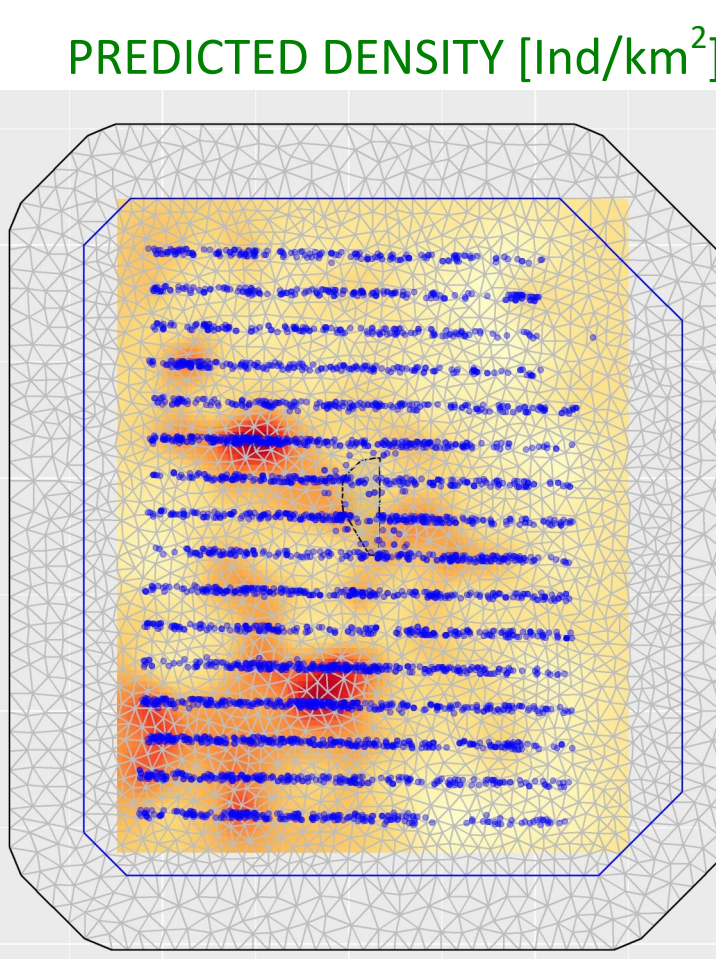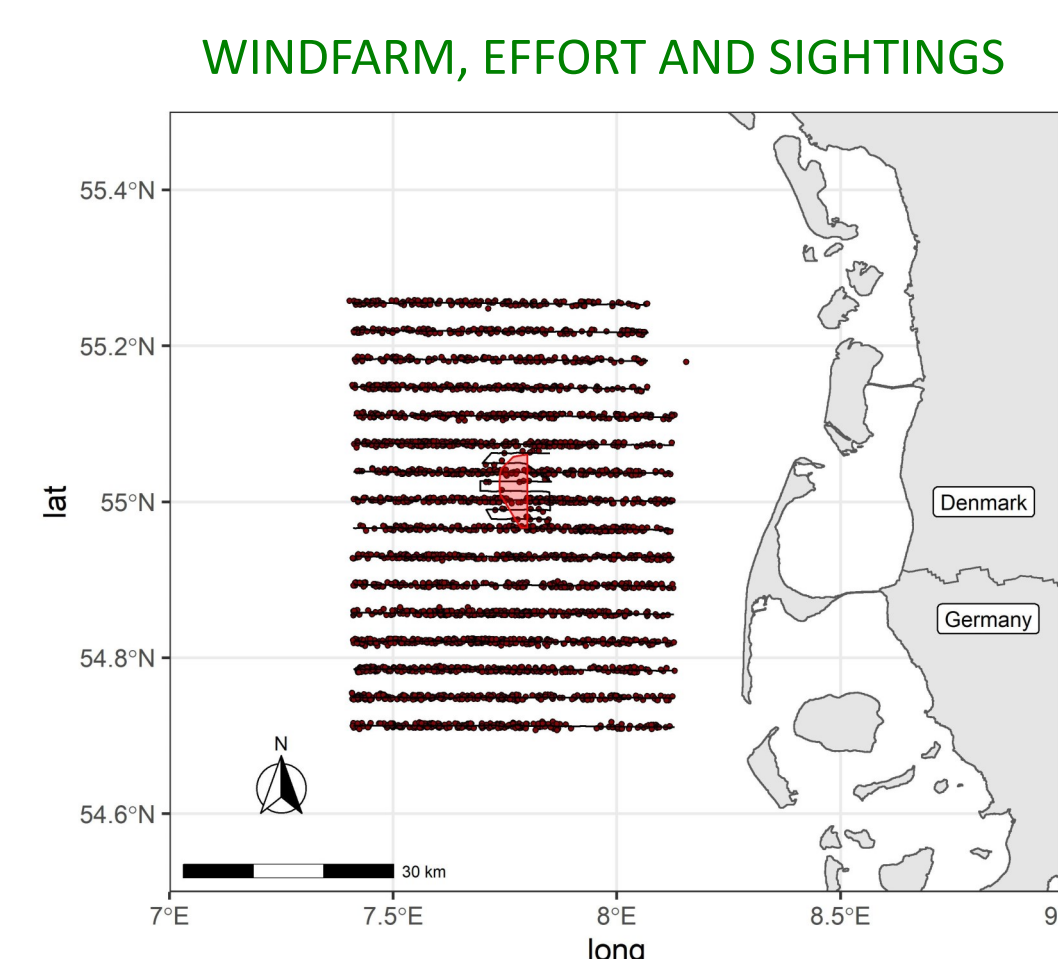3 SPECIES WERE OBSERVED DURING THE STUDIED PERIOD:
- HARBOUR PORPOISE (*Phocoena phocoena*)
- HARBOUR SEAL (*Phoca vitulina*)
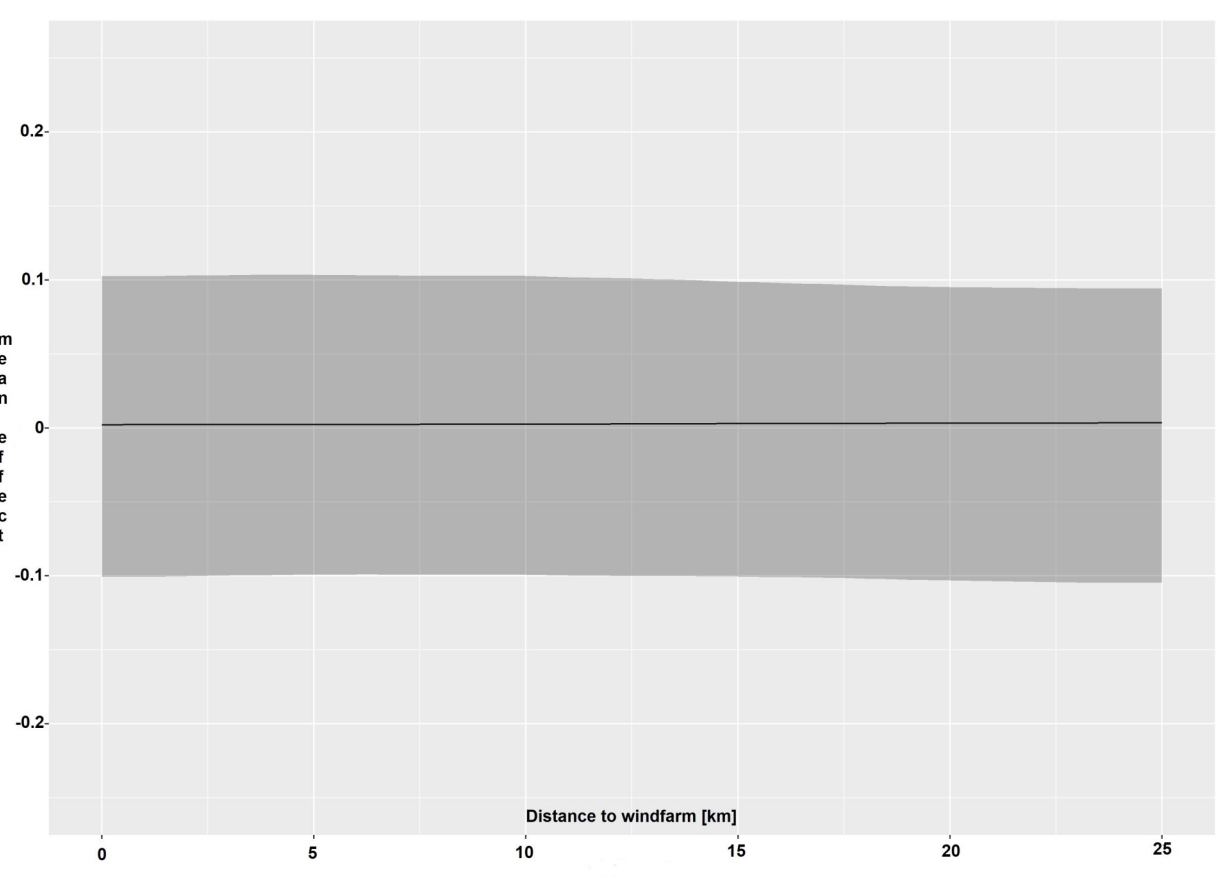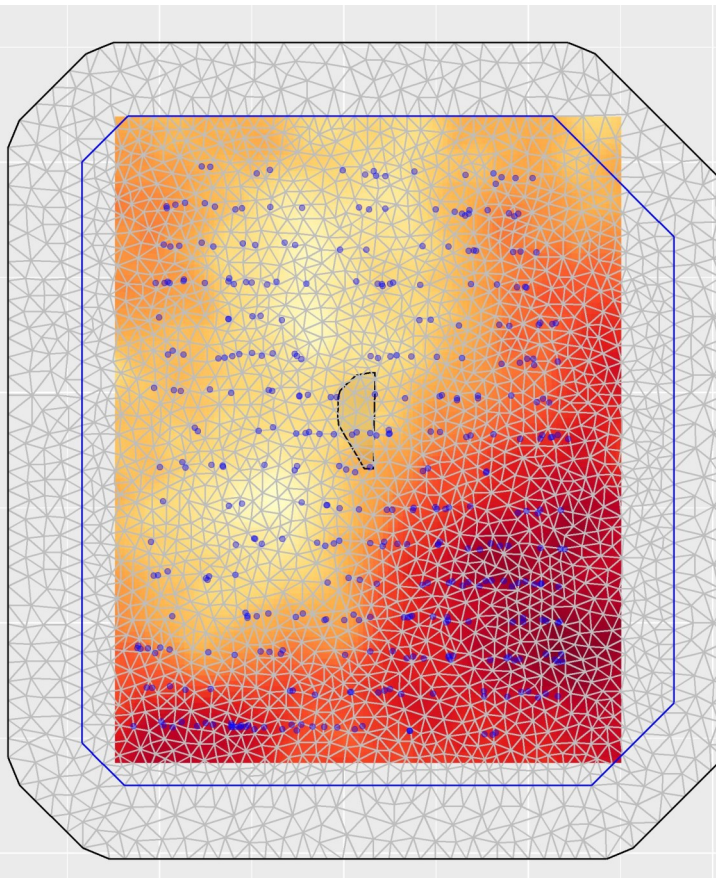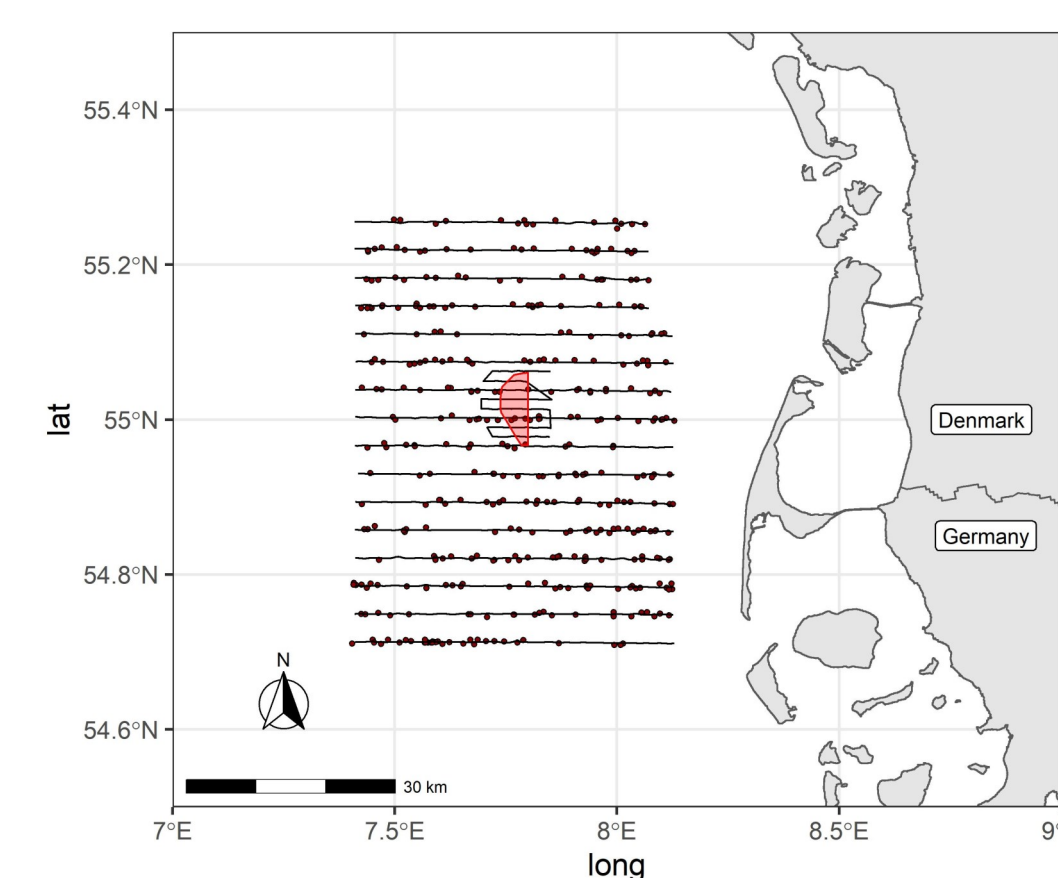- GREY SEAL (*Halichoerus grypus*)

Red box indicates the study area

WINDFARM, EFFORT AND SIGHTINGS
PREDICTED DENSITY [Ind/km^2]
WINDFARM EFFECT (Y-AXIS) VS DISTANCE (X-AXIS)
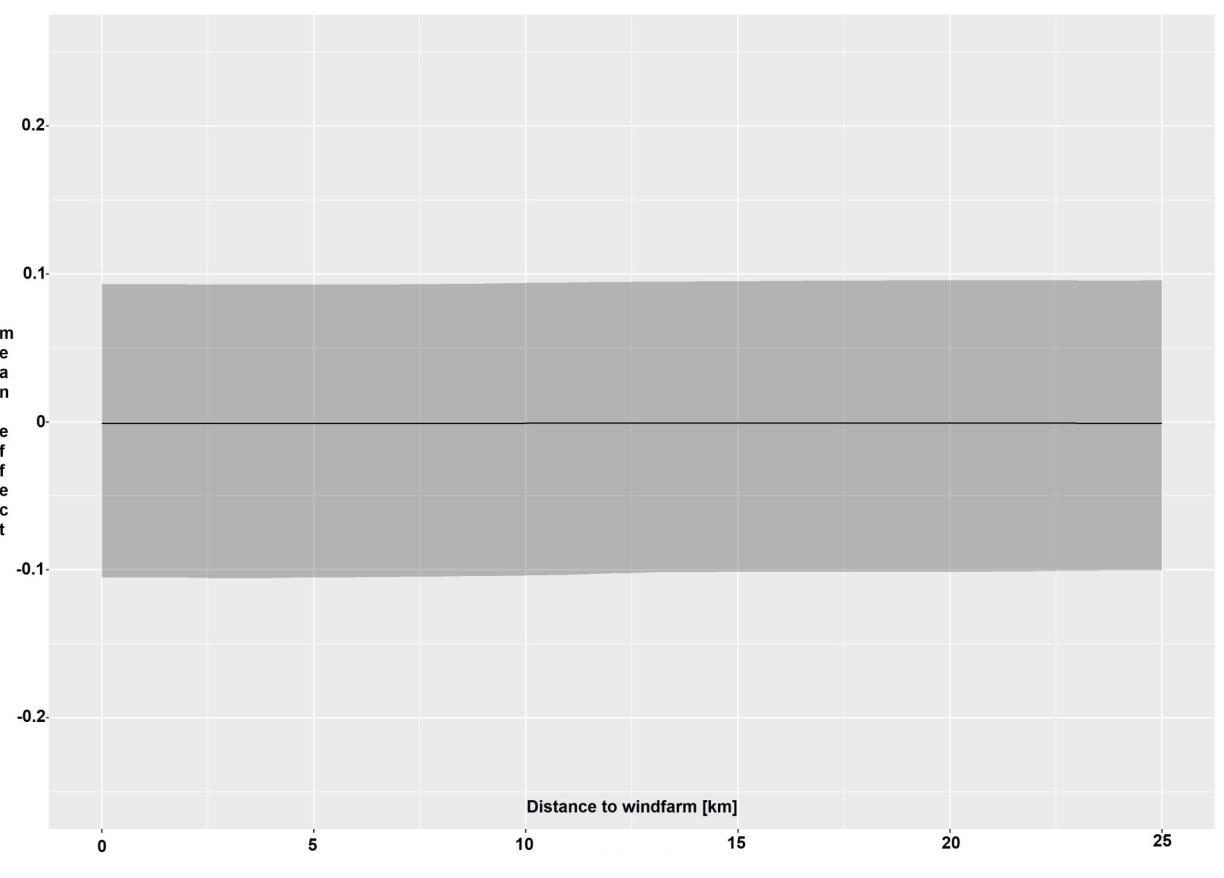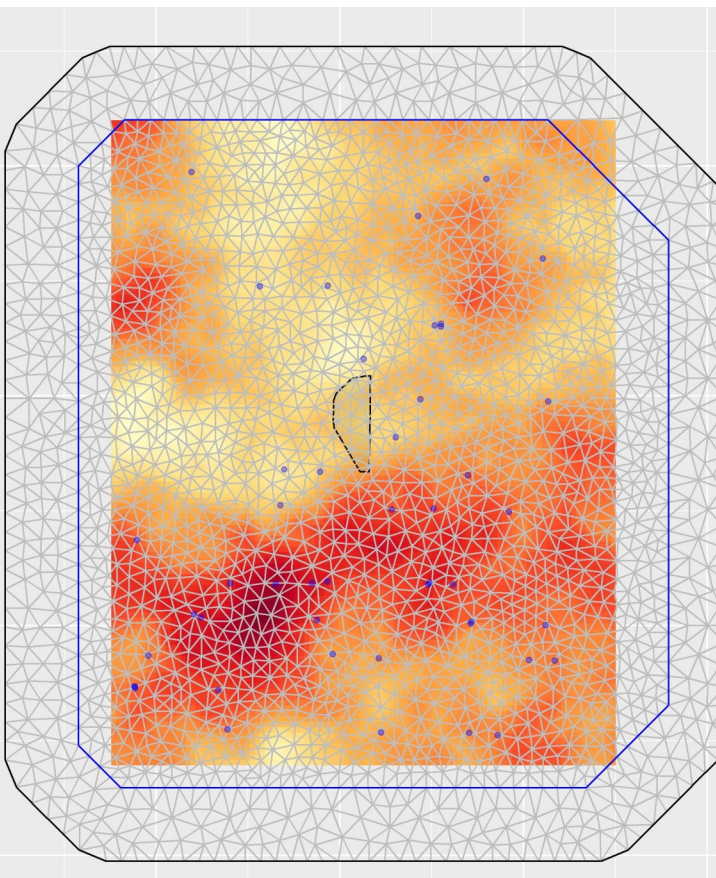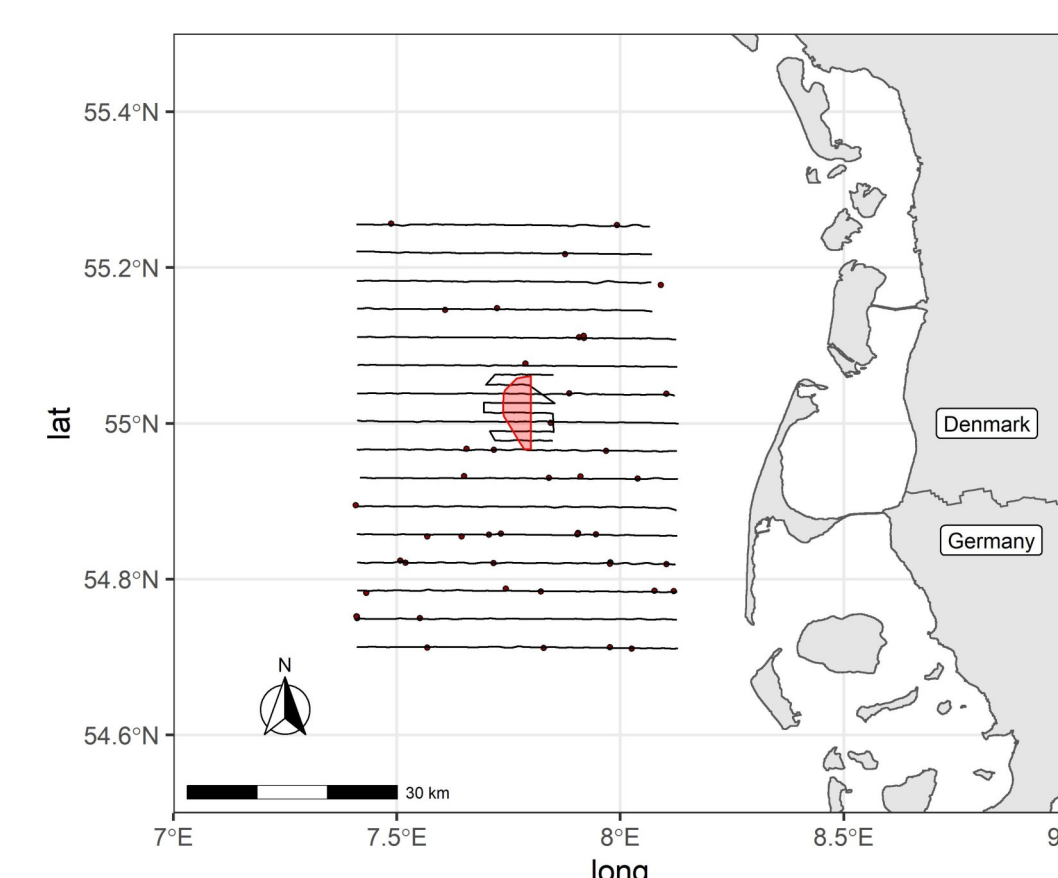
HARBOUR PORPOISE
- 4215 SIGHTINGS
- NO WINDFARM EFFECT OBSERVED

HARBOUR SEAL
- 392 SIGHTINGS
- NO WINDFARM EFFECT OBSERVED

GREY SEAL
- 47 SIGHTINGS
- NO WINDFARM EFFECT OBSERVED

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REFS: [1] TEILMANN, Jonas; CARSTENSEN, Jacob. Negative long term effects on harbour porpoises from a large scale offshore wind farm in the Baltic—evidence of slow recovery. *Environmental Research Letters*, 2012, vol. 7, no 4, p. 045101. [2] RUSSELL, Deborah JF, et al. Marine mammals trace anthropogenic structures at sea. *Current Biology*, 2014, vol. 24, no 14, p. R638-R639. [3] RUSSELL, Debbie JF, et al. Avoidance of wind farms by harbour seals is limited to pile driving activities. *Journal of Applied Ecology*, 2016, vol. 53, no 6, p. 1642-1652. [4] RUE, H., MARTINO, S. & CHOPIN, N. 2009. Approximate Bayesian inference for latent Gaussian models by using integrated nested Laplace approximations. Journal of the Royal Statistical Society: Series B (Statistical Methodology) 71:319–392. [5] LINDGREN, F., RUE, H. & LINDSTRÖM, J. 2011. An explicit link between Gaussian fields and Gaussian Markov random fields: the stochastic partial differential equation approach: Link between Gaussian Fields and Gaussian Markov Random Fields. Journal of the Royal Statistical Society: Series B (Statistical Methodology) 73:423–498 [6] ZYDELIS, R., DORSCH, M., HEINÄNEN, S., NEHLS, G. & WEISS, F. 2019. Comparison of digital video surveys with visual aerial surveys for bird monitoring at sea. Journal of Ornithology [7] R CORE TEAM. 2019. A Language and Environment for Statistical Computing. R Foundation for Statistical Computing. [8] BACHL, F. E., LINDGREN, F., BORCHERS, D. L. & ILLIAN, J. B. 2019. inlabru: an R package for Bayesian spatial modelling from ecological survey data. Methods in Ecology and Evolution 10:760–766.