

# RESULTS OF ORNITHOLOGICAL ANALYSIS FOR A UK OFFSHORE WIND FARM

ROBIN RIGG, SOLWAY, SCOTLAND

International Energy Agency's Wind Task 34  
Webinar  
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**WIND**

**MARINE**

**BIOMASS**



# OVERVIEW

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**ROBIN RIGG OFFSHORE WIND FARM**

**KEY SPECIES**

**SURVEY METHODS & ANALYSIS**

**ABUNDANCE ESTIMATES**

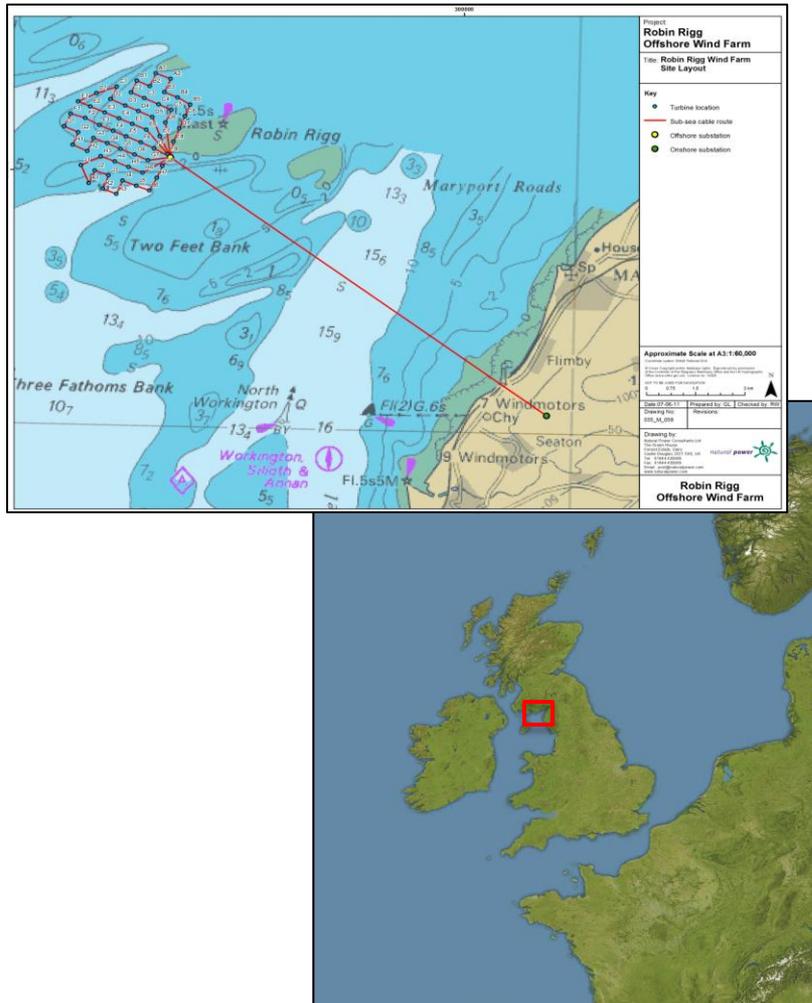
**DENSITY SURFACE MAPS**

**SUMMARY**

**FUTURE MONITORING**



# ROBIN RIGG OFFSHORE WIND FARM



- ▶ **60 turbines (180 MW)**
- ▶ **Baseline EIA 2001-2002**
- ▶ **Granted consent in March 2003**
- ▶ **Constructed from January 2008 – Feb 2010**
- ▶ **Operational from April 2010**

## KEY SPECIES

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➤ **Guillemot** *Uria aalge*



➤ **Razorbill** *Alca torda*



➤ **Gannet** *Morus bassanus*

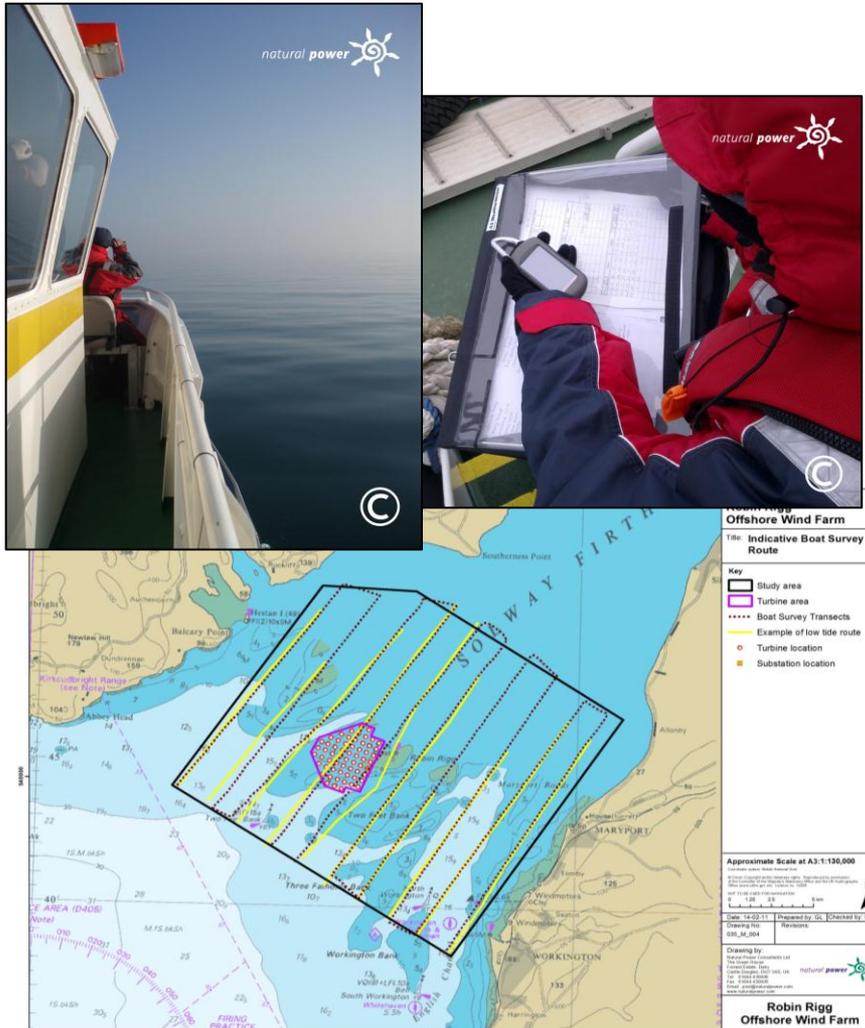


➤ **Red-throated diver** *Gavia stellata*

➤ **Cormorant** *Phalacrocorax carbo*

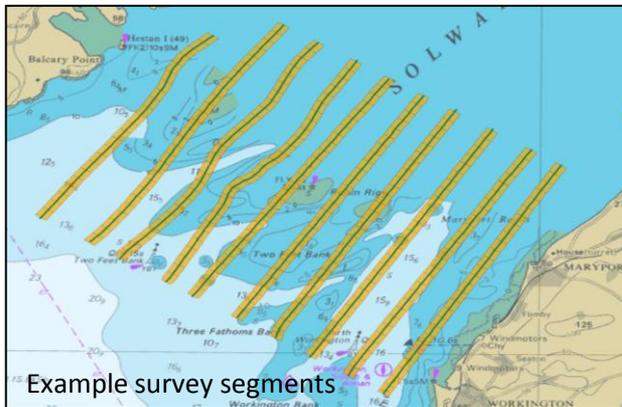
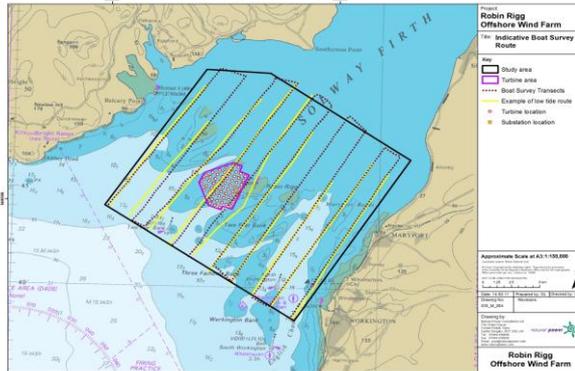


# SURVEY METHODS



- Boat-based Distance transect surveys (ESAS method)
- Surveys from 2004 - 2012
- One survey per month pre-construction & operation (high & low tide)
- 2 surveys per month during construction (1 high & 1 low tide)
- 10 transects, 18 km long, 2 km apart

# ANALYSIS – DENSITY SURFACE MODELS



- Survey data segmented
- Covariates extracted for each segment
- Dataset specific modelling techniques selected for each species
- Prior to analysis data checked for:
  - collinearity among covariates;
  - spatio-temporal autocorrelation;
  - Zero-inflation in the response variable.
- Solutions were to:
  - identify collinear variable & remove from analysis
  - Include a random effect representing position in time & space
  - use of a mixture model

# ANALYSIS – DENSITY SURFACE MODELS

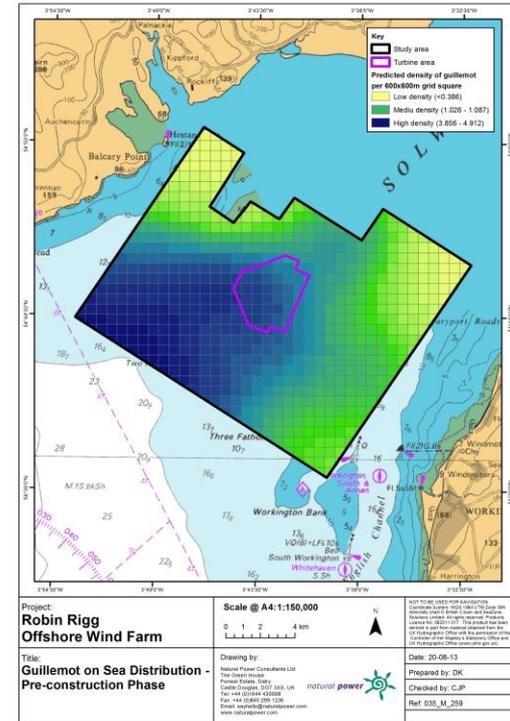
➤ **Covariates examined included:**

- **water depth;**
- **distance to coast;**
- **distance to the wind farm;**
- **sediment type;**
- **latitude & longitude;**
- **month (or season); and**
- **time of day**

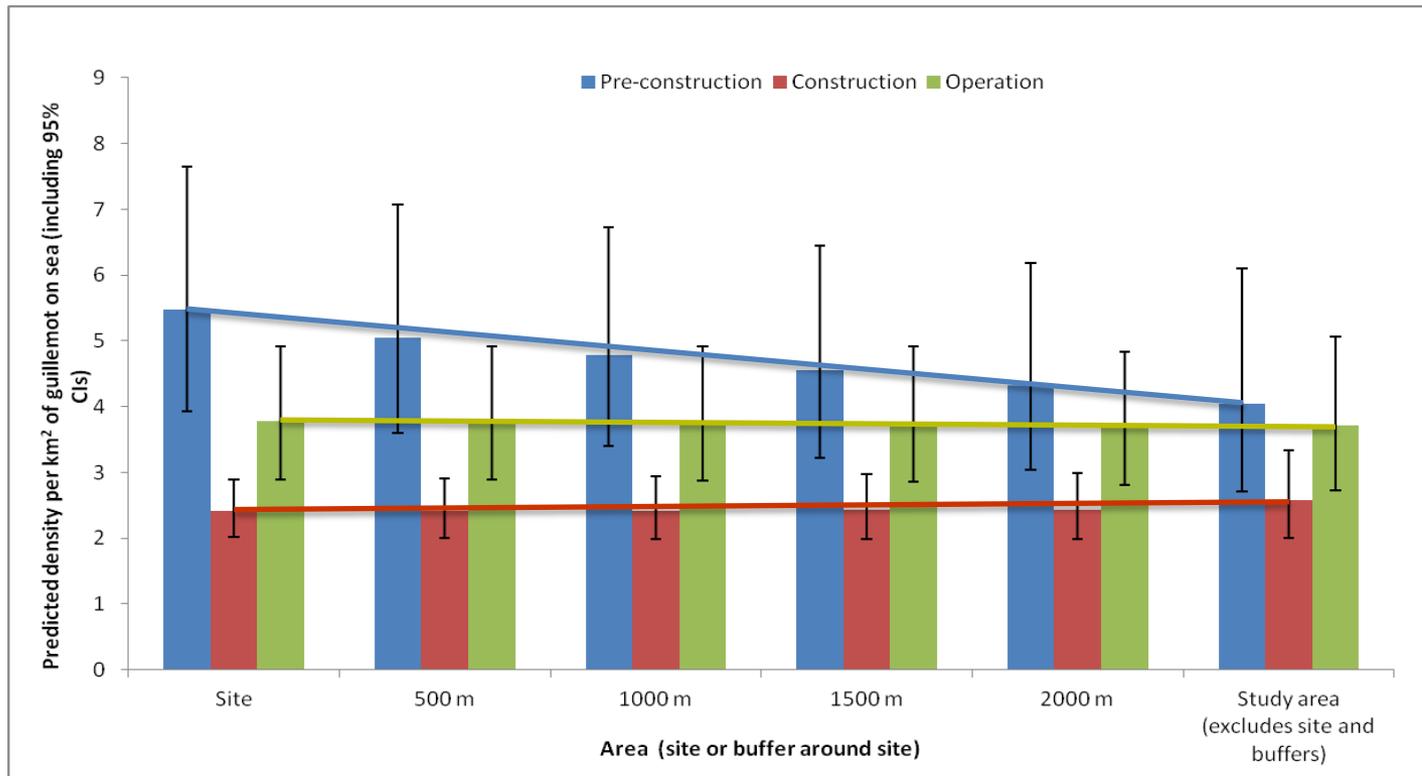
} **FINAL MODEL**

➤ **Zero-inflated mixed additive models using Bayesian**

**inference incorporating non-linear covariates, a random effect for spatial autocorrelation and binary part for zero-inflation.**



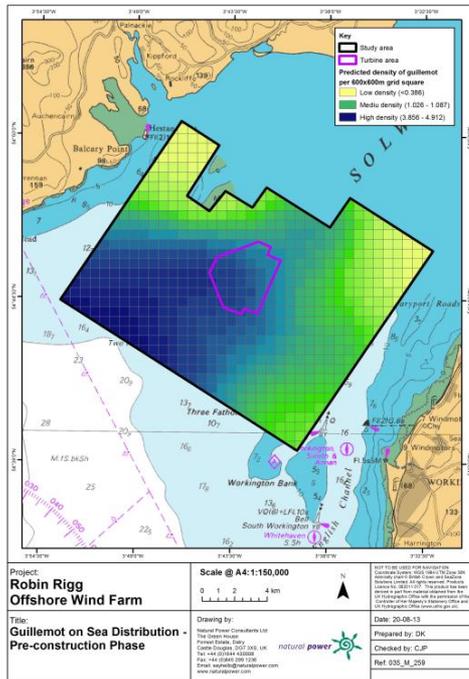
# ABUNDANCE – PRE-CONSTRUCTION TO OPERATIONAL



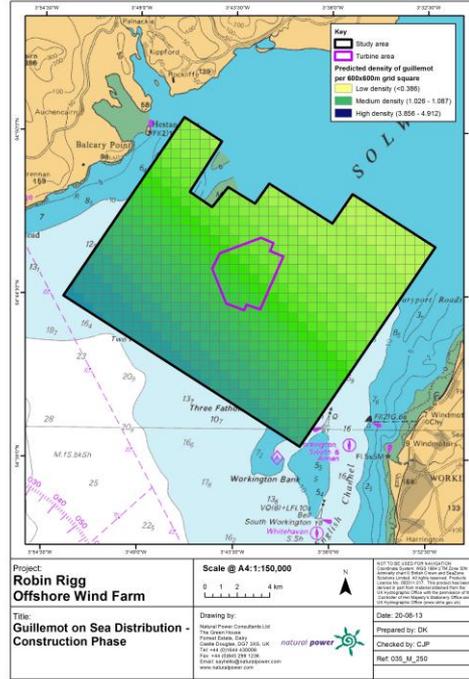
Guillemot *Uria aalge*

# SPATIAL ABUNDANCE - GUILLEMOT *Uria aalge*

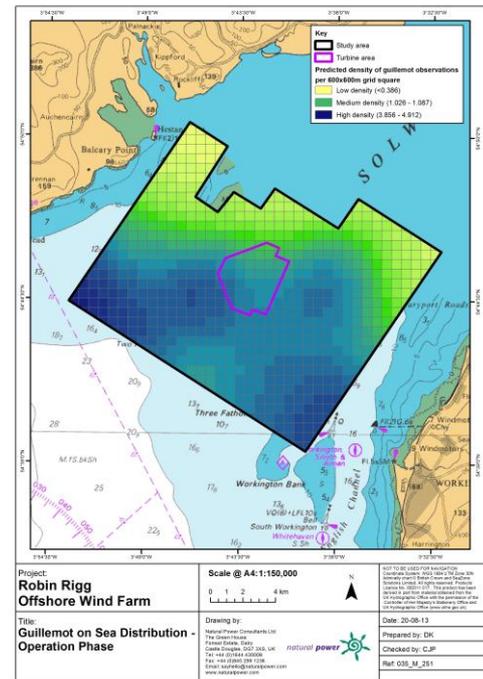
## Birds on the water.



**Pre-construction phase**  
 Site: 2.8 km<sup>2</sup>  
 Buffer: 1.8 km<sup>2</sup>



**Construction phase**  
 Site: 0.7 km<sup>2</sup>  
 Buffer: 1.2 km<sup>2</sup>

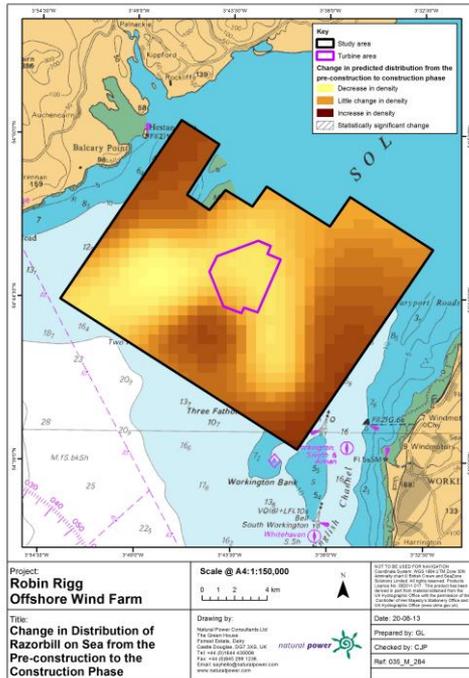


**Operational phase**  
 Site: 1.5 km<sup>2</sup>  
 Buffer: 1.9 km<sup>2</sup>

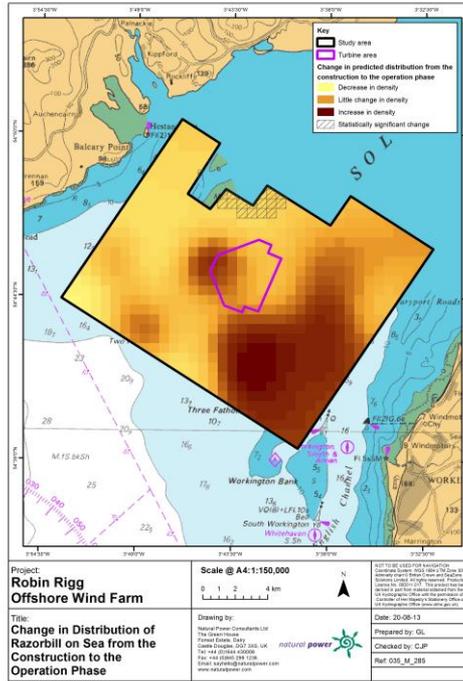


# CHANGE IN SPATIAL ABUNDANCE - RAZORBILL *Alca torda*

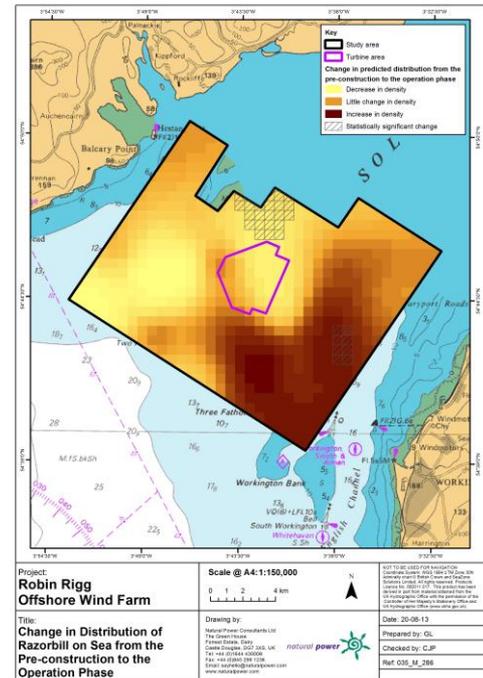
## Birds on the water.



**Pre-construction to Construction phase**  
 Site: 0.98 to 0.34 km<sup>-2</sup>  
 Buffer: 0.59 to 0.59 km<sup>-2</sup>



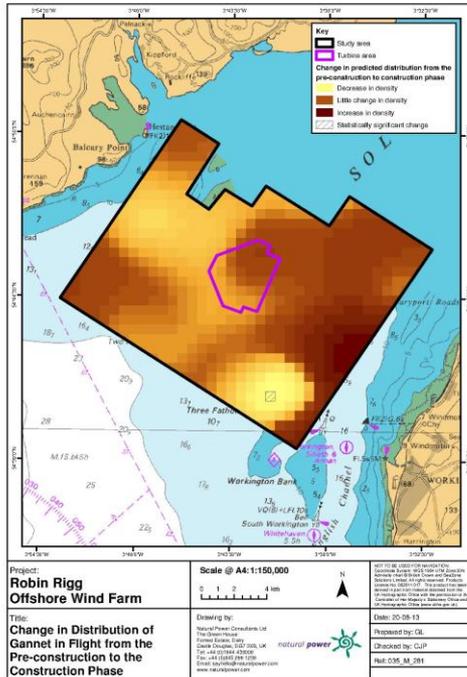
**Construction to Operational phase**  
 Site: 0.34 to 0.34 km<sup>-2</sup>  
 Buffer: 0.59 to 1.01 km<sup>-2</sup>



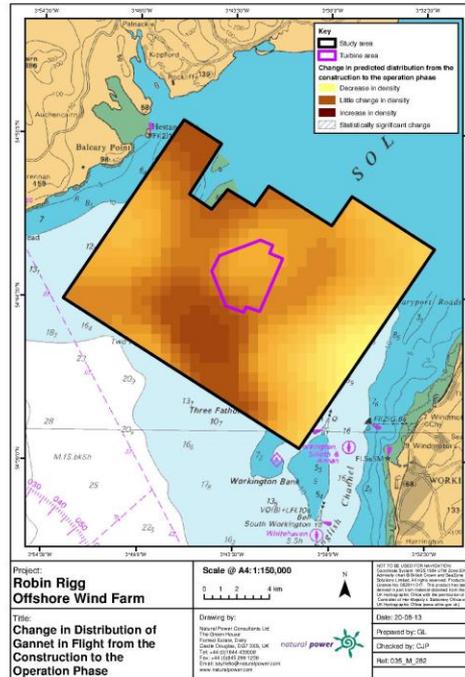
**Pre-construction to Operational phase**  
 Site: 0.98 to 0.34 km<sup>-2</sup>  
 Buffer: 0.59 to 1.01 km<sup>-2</sup>

# CHANGE IN SPATIAL ABUNDANCE - GANNET *Morus bassanus*

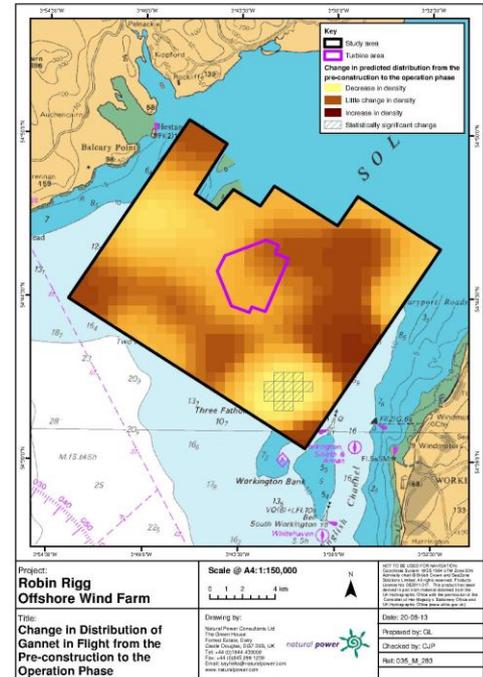
## Birds in flight.



**Pre-construction to  
Construction phase**  
 Site: 0.18 to 0.27 km<sup>-2</sup>  
 Buffer: 0.17 to 0.20 km<sup>-2</sup>



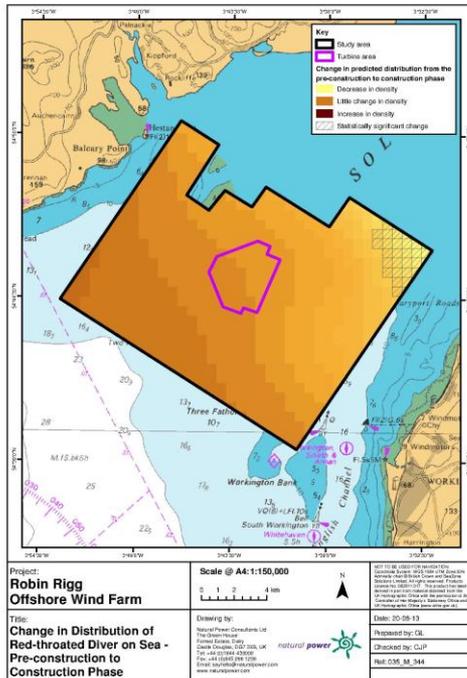
**Construction to  
Operational phase**  
 Site: 0.27 to 0.01 km<sup>-2</sup>  
 Buffer: 0.20 to 0.14 km<sup>-2</sup>



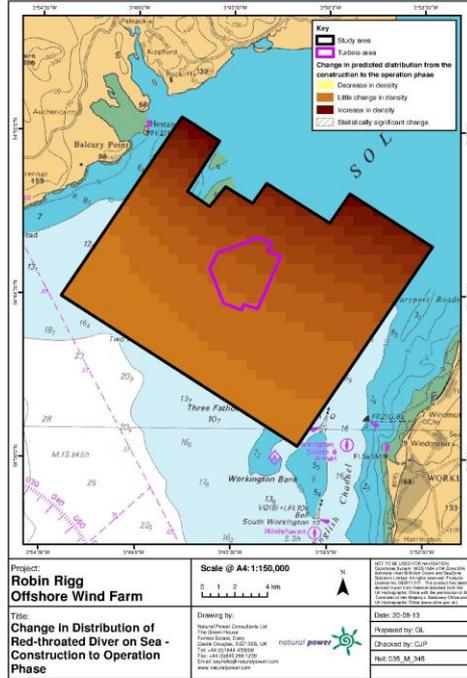
**Pre-construction to  
Operational phase**  
 Site: 0.18 to 0.01 km<sup>-2</sup>  
 Buffer: 0.17 to 0.14 km<sup>-2</sup>

# CHANGE IN SPATIAL ABUNDANCE - RED-THROATED DIVER *Gavia stellata*

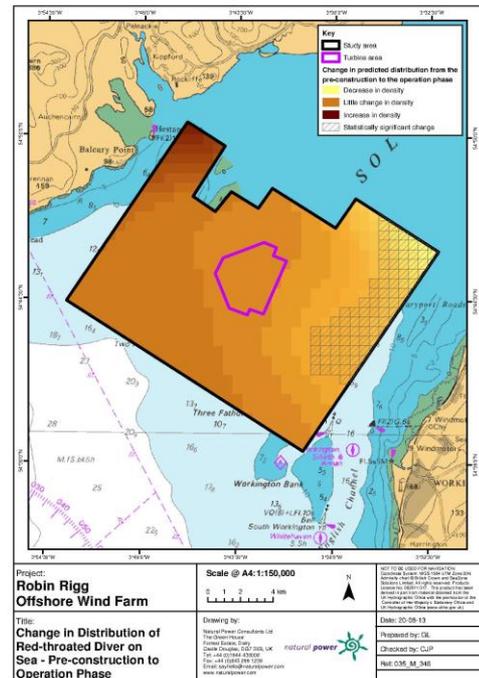
## Birds on the water.



**Pre-construction to  
Construction phase**  
 Site: 0.08 to 0.0 km<sup>-2</sup>  
 Buffer: 0.31 to 0.03 km<sup>-2</sup>



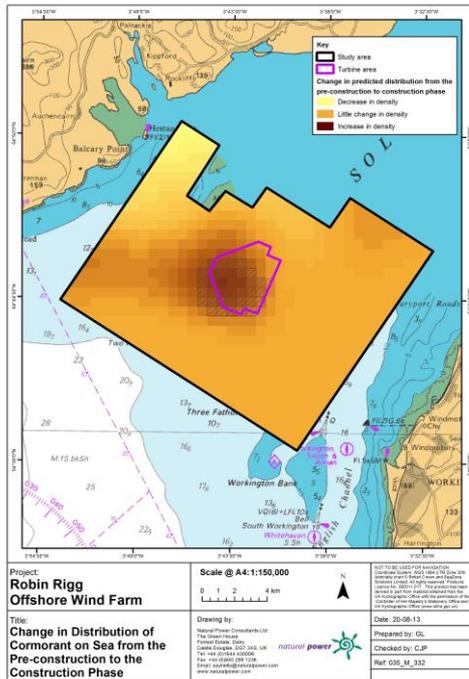
**Construction to  
Operational phase**  
 Site: 0.0 to 0.01 km<sup>-2</sup>  
 Buffer: 0.03 to 0.08 km<sup>-2</sup>



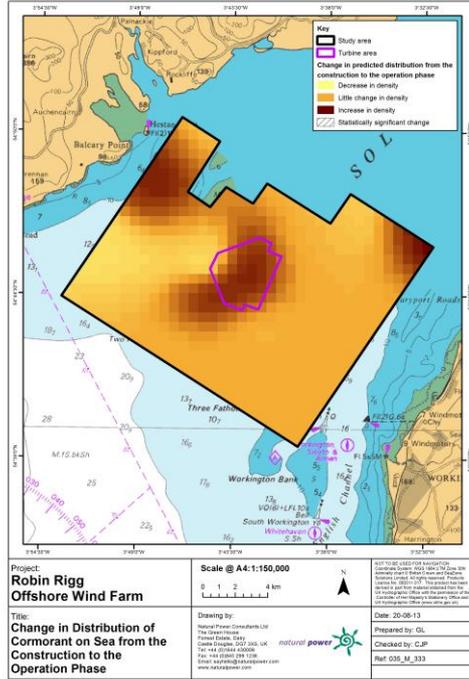
**Pre-construction to  
Operational phase**  
 Site: 0.08 to 0.01 km<sup>-2</sup>  
 Buffer: 0.31 to 0.08 km<sup>-2</sup>

# CHANGE IN SPATIAL ABUNDANCE - CORMORANT *Phalacrocorax carbo*

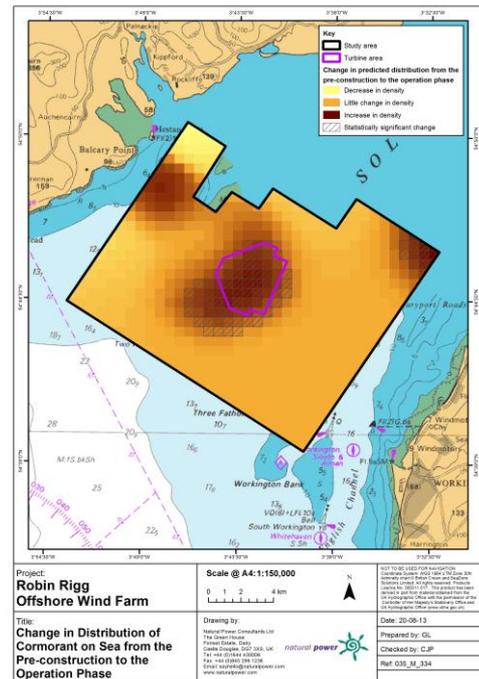
## Birds on the water.



**Pre-construction to Construction phase**  
 Site: 0.17 to 0.98 km<sup>-2</sup>  
 Buffer: 0.06 to 0.08 km<sup>-2</sup>



**Construction to Operational phase**  
 Site: 0.98 to 1.9 km<sup>-2</sup>  
 Buffer: 0.08 to 0.20 km<sup>-2</sup>



**Pre-construction to Operational phase**  
 Site: 0.17 to 1.9 km<sup>-2</sup>  
 Buffer: 0.06 to 0.20 km<sup>-2</sup>

## SUMMARY

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➤ **Most species showed change in abundance and density**

Hard to attribute this to the wind farm

➤ **Some species showed declines**

Guillemot & Red-throated diver

➤ **Some species showed increases**

Cormorant (& Herring gull)

➤ **Some species showed little change**

Gannets changed little but densities generally low



# CONCLUSIONS

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- ④ **Difficult data sets requiring (relatively) complex analysis**
  - Spatial autocorrelation & zero inflation
- ④ **Changes not significant for most species**
  - Potential declines: guillemot & red-throated diver
  - Increases in cormorant
- ④ **Hard to attribute change to the wind farm**
  - Power to detect change low?
- ④ **Simple analysis of wind farm vs buffer insufficient**
  - Patterns of spatial distribution important
- ④ **Future EIAs need to be able to incorporate complex results more fully**
  - Displacement complex, not simple percentages

Report available at:

<http://www.scotland.gov.uk/Topics/marine/Licensing/marine/scoping/Robin-Rigg/memp2>

# FUTURE MONITORING

➤ **Boat-based surveys alone can produce useful results**

large complex data sets requiring careful analysis

➤ **Statistical power can be low**

Is this indicative of a good location for a wind farm?

➤ **Empirical evidence should be applied to EIA**

Is some evidence always better than none?

How should complex results inform EIA?

➤ **Scale is important**

Based on receptors not projects



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