

**NATURAL POWER'S ENVIRONMENTAL STATISTICS AND ANALYSIS TEAM HELPS YOU ENSURE THAT SURVEY DESIGN, DATA COLLECTION AND DATA ANALYSIS INFORM ROBUST ASSESSMENTS OF ECOLOGICAL AND HYDROLOGICAL ISSUES AT ONSHORE AND OFFSHORE SITES.**

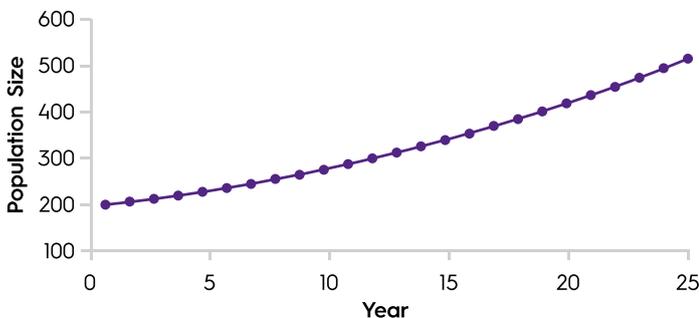
**We balance the needs of the budget against project requirements by exploiting the full potential of survey data.**

Year 0				Year 1				Year 2
$N_1^0$	0	0	$F_3^1$	$N_1^1$	0	0	$F_3^2$	$N_1^2$
$N_2^0$	$P_{21}^1$	$P_{22}^1$	0	$N_2^1$	$P_{21}^2$	$P_{22}^2$	0	$N_2^2$
$N_3^0$	0	$P_{32}^1$	$P_{33}^1$	$N_3^1$	0	$P_{32}^2$	$P_{33}^2$	$N_3^2$

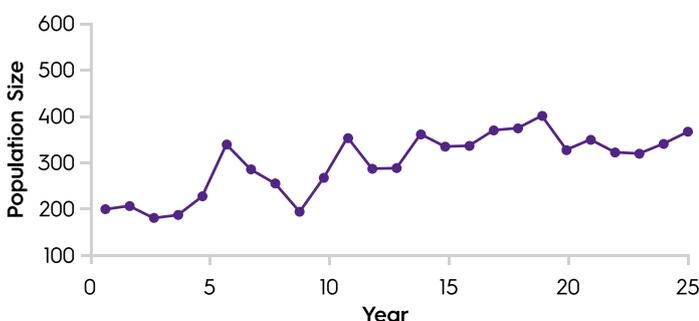
We provide the following services:

- Survey design and power analysis
- Population estimation e.g. Distance Sampling
- Avian territory predictions
- Avian Collision Risk Analysis
- Population modelling, including PVA (Population Viability Analysis), PBR (Potential Biological Removal), and Resource Selection Functions
- Benthic community analysis using PRIMER
- Fish data analysis (catch analysis)
- Peat modelling
- Topographic modelling, Flow Accumulation, Topographic Wetness, and Watershed Delineation
- Ground water modelling
- Analysis of post-construction v baseline data including use of MRSea
- Modelling rates of bird and bat mortality at wind farms
- Analysis and presentation of data using a range of GIS packages and functionalities (QGIS, ArcGIS, R)
- R programming

## DETERMINISTIC POPULATION GROWTH



## STOCHASTIC POPULATION GROWTH



**300+**  
YEARS  
ENVIRONMENTAL  
EXPERIENCE

**126**  
ENVIRONMENTAL  
PROJECTS

**65**  
ENVIRONMENTAL  
EXPERTS

**2**  
ECOLOGICAL  
MODELLERS



**// we take an analytical approach to ensuring that environmental impacts are appropriately considered //**

**GILLIAN VALLEJO** ECOLOGICAL MODELLER

## ORNITHOLOGICAL ASSESSMENT FOR HABITAT REGULATIONS ASSESSMENT FOR MORAY FIRTH OFFSHORE WIND DEVELOPMENT, SCOTLAND

**01** Natural Power used distance sampling and spatial modelling (GLMMs) to predict numbers of key seabird species using the proposed development site from survey data and then used displacement analysis and collision risk modelling (CRM) to assess likely impacts on these birds. The team developed bespoke species-specific population viability analyses (PVAs) to assess the likely population level impacts of these local effects for multiple populations in consultation with a range of statutory and non-statutory bodies. Sensitivity analyses were run to assess the relative importance of different input parameters on the PVA model predictions. Since this time, Natural Power has also been involved in the proposal of a species-specific baseline/post-construction monitoring program for the Moray Firth development, entailing a power analysis involving iterative data simulation and analysis, in order to identify the survey effort required to detect changes in numbers of individuals using the site.

## PEAT DEPTH MODELLING AT THE PEN Y CYMOEDD ONSHORE WIND FARM, WALES

**02** Natural Power used innovative machine learning methods (Boosted Regression Trees) to identify and map areas of deep peat. Identifying areas of deep peat at a site as large as this would usually require labour-intensive peat depth monitoring over extensive areas, involving thousands of peat depth probes at 100 m intervals. However, the team were able to use preliminary data collected at the site to model the likelihood of deep peat presence across the site. The resulting probability surface indicated areas where minimal ground-truthing would be required in which the model strongly predicted either the presence (i.e. probability of presence >70 %) or the absence (i.e. probability of presence <30 %) of deep peat. This meant that peat depth monitoring could instead be targeted to areas of high model uncertainty (i.e. probability of presence 30-70%). This approach reduces costs to clients and increases efficiency of surveying very large sites.



## ANALYSIS OF THE IMPACT OF THE ROBIN RIGG WIND FARM ON A RANGE OF TAXA, SCOTLAND

**03** Natural Power investigated the impacts of the Robin Rigg wind farm using more than ten years' worth of fish, benthic, bird and marine mammal data collected across all phases of the wind farm development. This involved using a diverse array of statistical tools including spatial modelling of complex datasets (Zero-inflated Generalised Mixed Effects Models, Generalised Estimating Equations and Complex Regional Spatial Smoothing as implemented using the MRSea package in R) and PRIMER analysis for biotope characteristic and invertebrate community comparison (including AMOSIM, MDS and SIMPER). These analyses are presented in a series of reports available to download from the Marine Scotland website and are currently published as a book chapter (Zuur et al., 2014) and in preparation as two peer-reviewed journal publications (Vallejo et al., in prep; Rutherford et al., in prep). The results showed no population level effects to wildlife studied, which should reduce stakeholder concerns on the long-term effects of offshore wind farms on important wildlife species.

