What's next and Why?
A look ahead at strategic research direction.

Most fertile areas of the terrestrial world - River Deltas used for habitation

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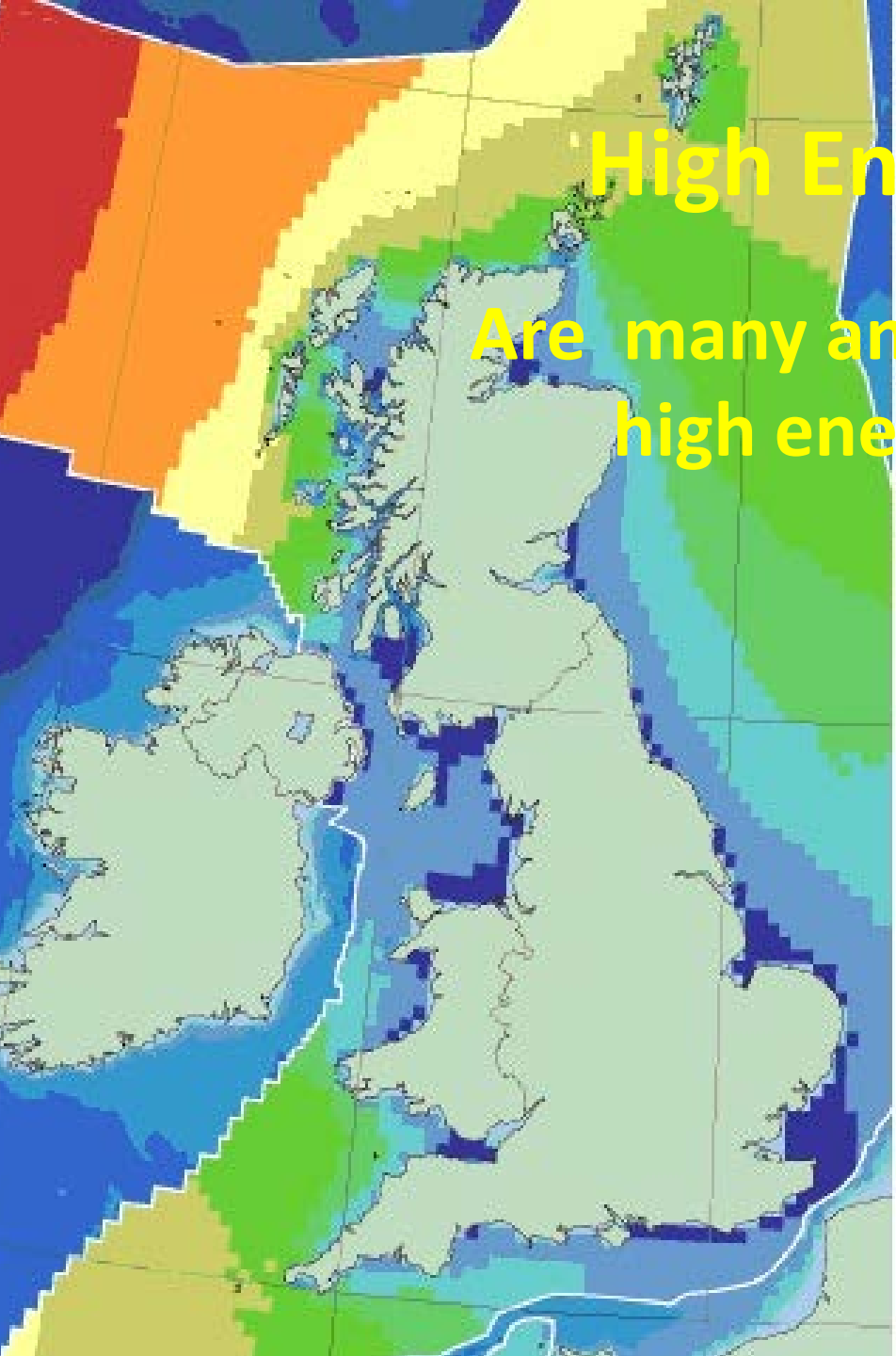
Most Productive areas of the seas:
Shelf areas next to continents

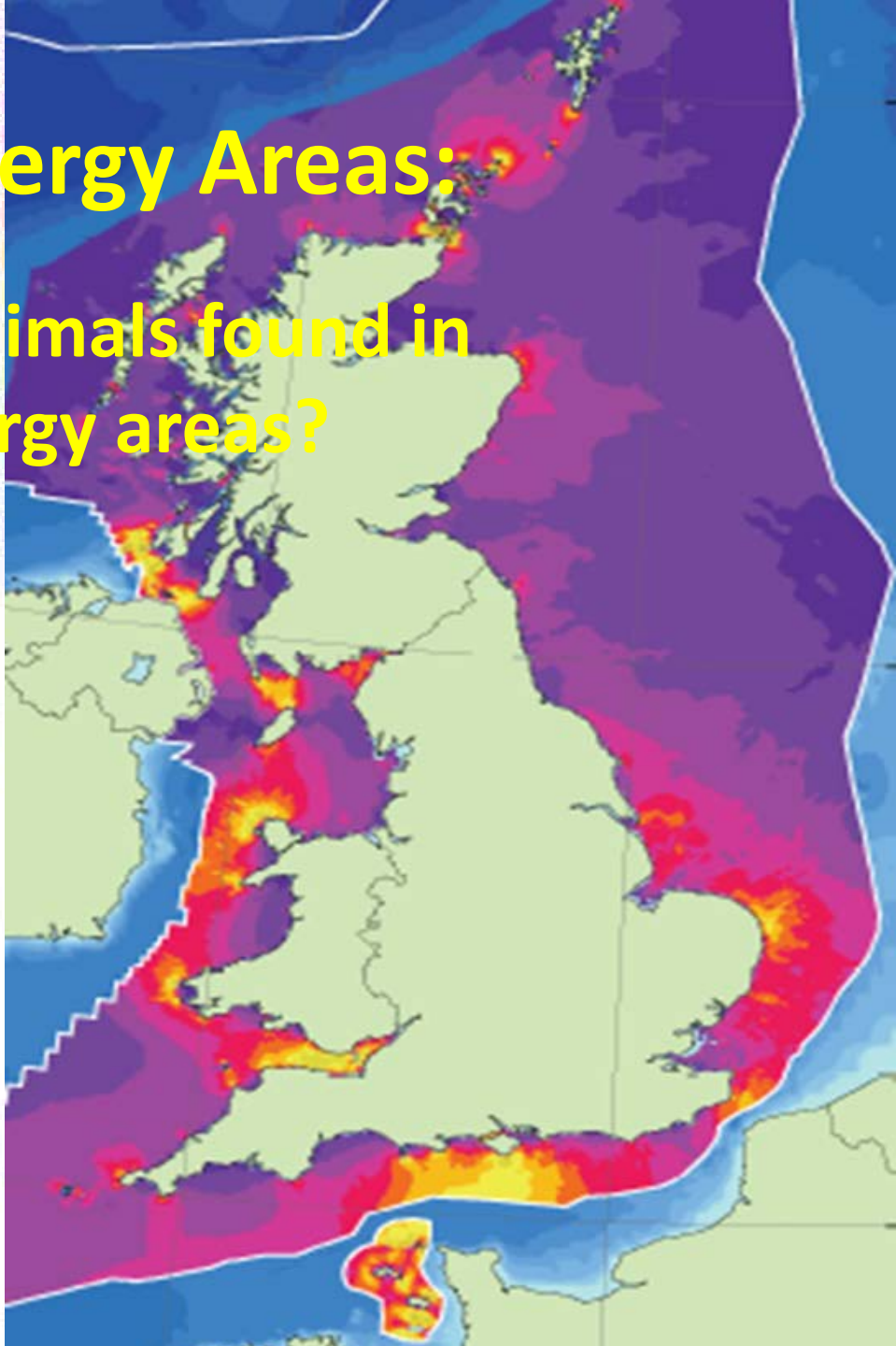
> 50% fish landings caught within 100 km of the coast in < 200m (only 7.5% of the world's oceans)

We need to look carefully NOW at the population level and ecosystem cumulative impact of all offshore activity

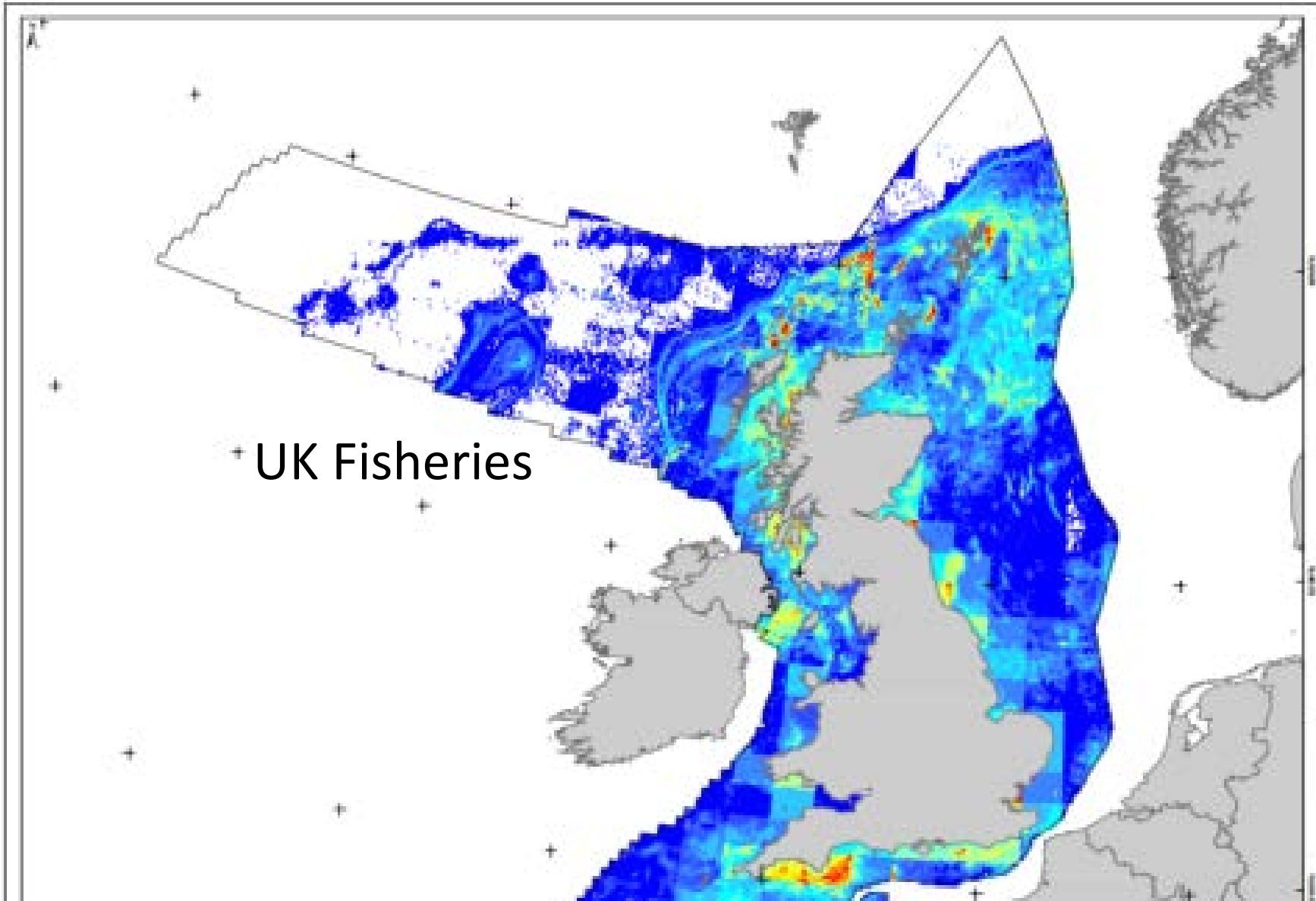
High Energy Areas:

Are many animals found in high energy areas?

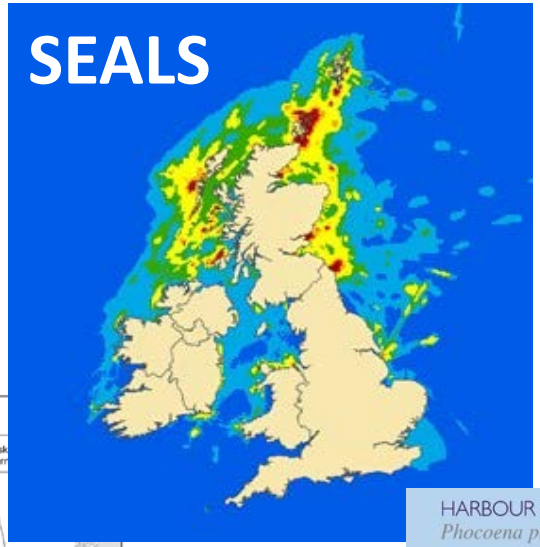


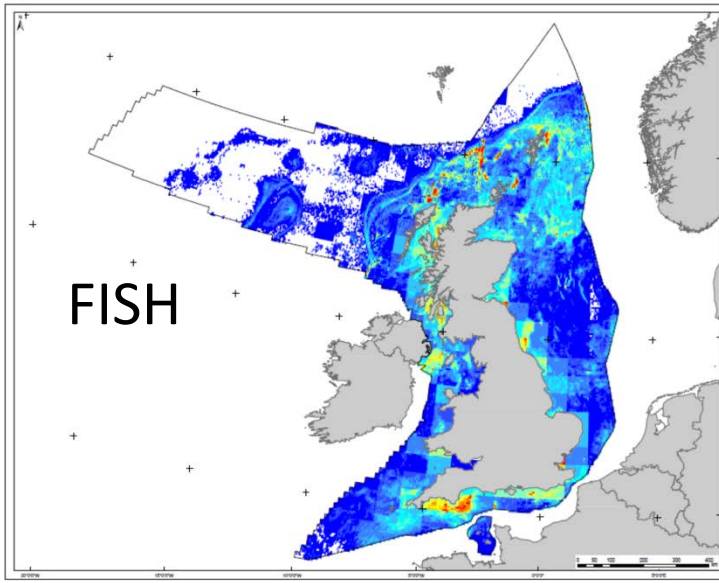


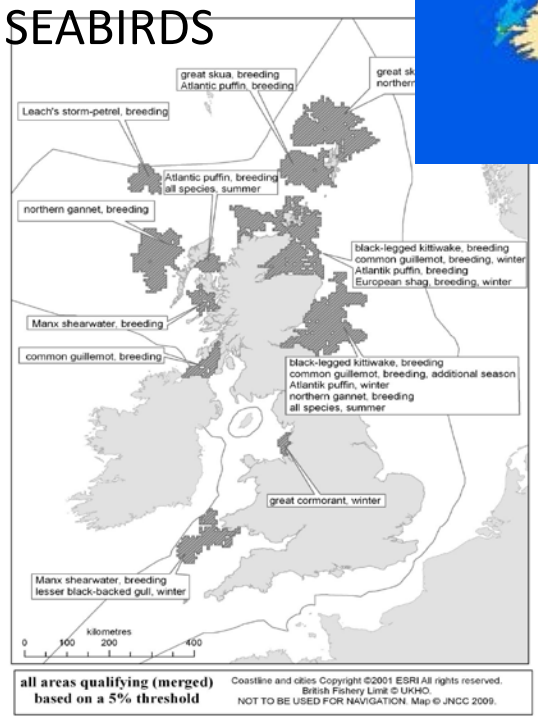
High Energy Areas: Are many animals found in high energy areas?

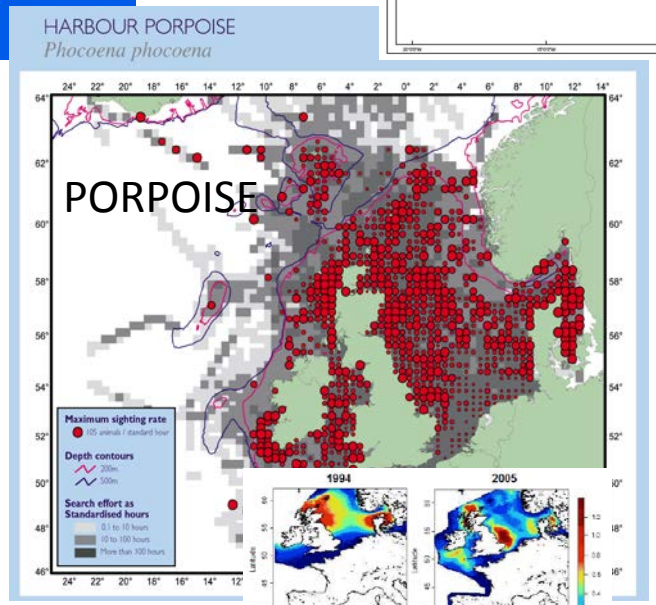


High Energy Areas: Are many animals found in high energy areas? YES!









Note where data sets are from: National

What we need to know. What are animals doing in these locations?

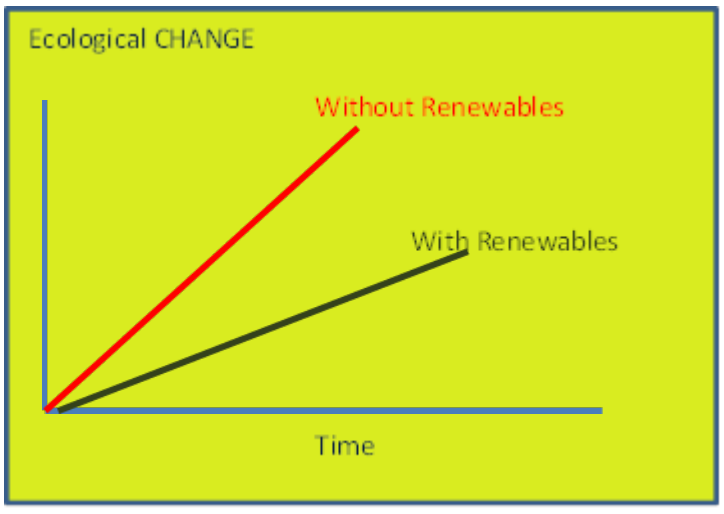
- What will change?
- Will it effect the behaviour of animals?
- Will it effect vital rates of populations?
- How do you define a population?

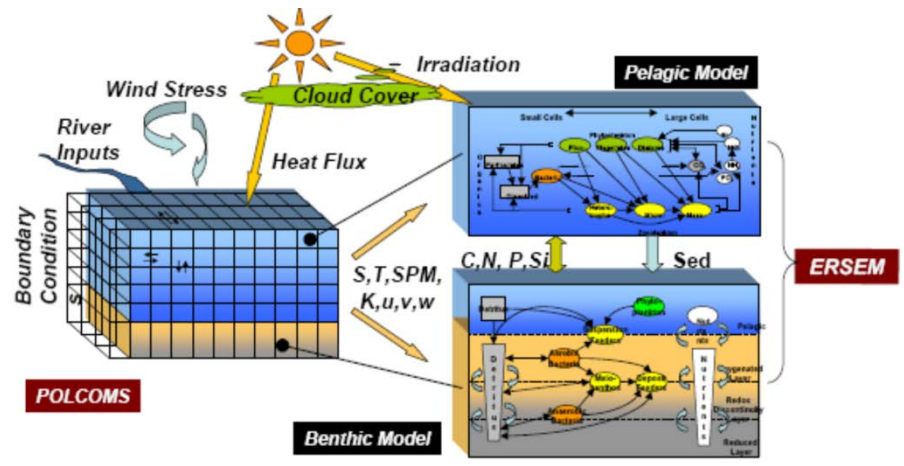
What types of field studies are increasing needed knowledge & certainty rapidly?

- Hypothesis driven studies linked to individual and population level models.
- Identify sensitive parameters to design fieldwork to collect needed parameter values at right frequency with enough power for proper statistical analysis

Link to Population/Ecosystem Models: does it make a difference?

- Ecosystem based – extracting energy will change mixing which will effect the base of the marine trophic chain – as mixing drives primary production
- How does energy extraction compare with changes due to climate change?





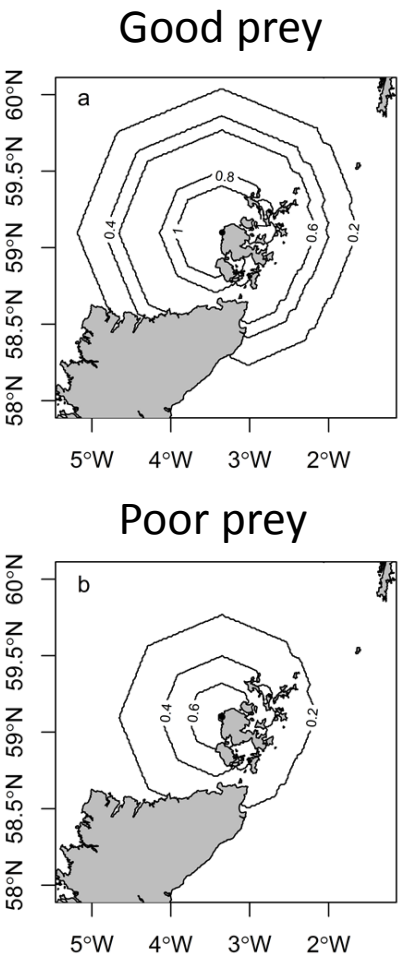
ERSEM = **E**uropean **R**egional **S**eas **E**cosystem **M**odel

Link to Population/Ecosystem Models: does it make a difference?

Individual based Mechanistic Behaviour Models allow exploration at population level

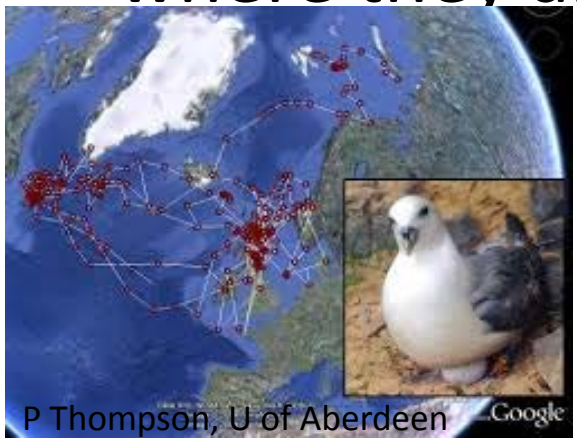
- eg. Seabirds energetic /breeding success
- Langton, Davies, Scott, (2014) & in prep – Distance for successful breeding given good & poor prey

- eg. Eulerian Lagrangian Agent Method (ELAM) – fish behavouir link to hydrodyamics (Gayle Zydlewski U of Maine)

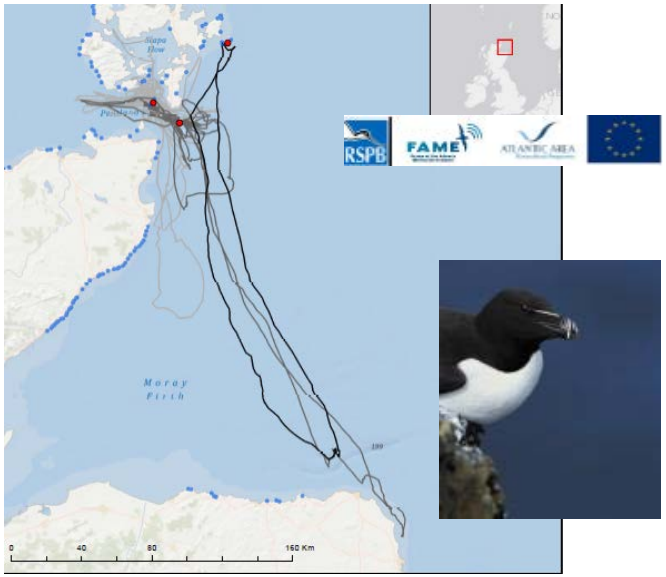


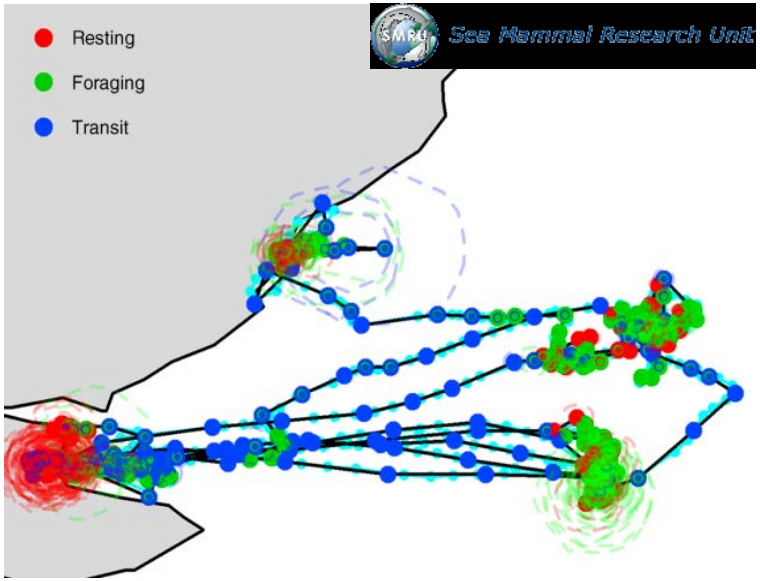
Tagging of individuals

- Learning rapidly what animals are doing, and where they are doing it, for how long, etc.



P Thompson, U of Aberdeen

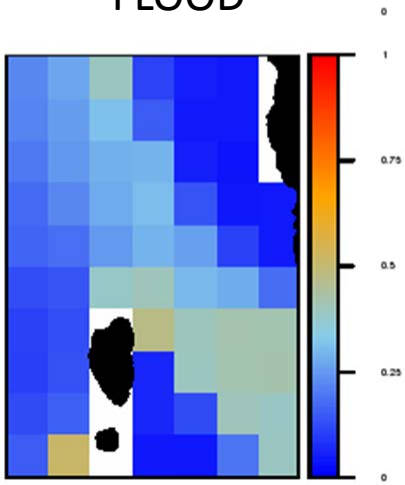




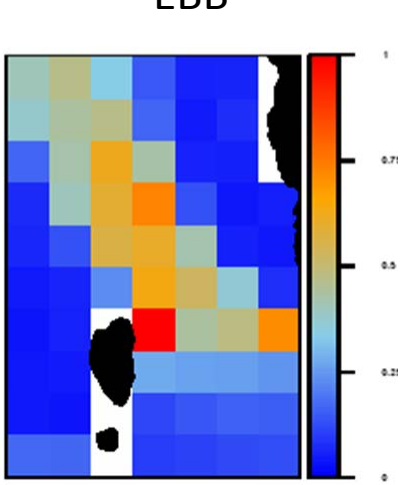
Intensive frequency surveys: both behaviour and physics

Rapid understanding use of micro-habitat: puffins using areas of high speed and eddy viscosity (Turbulence)

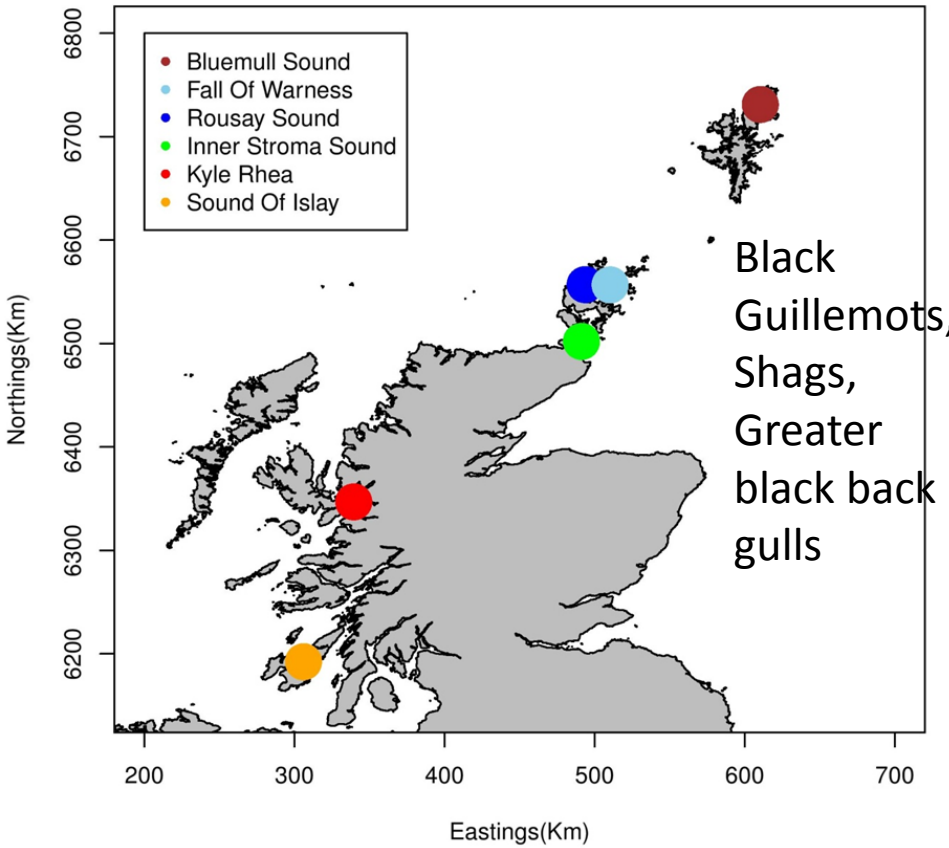
FLOOD



EBB



Statistical power to have comparison of multiple sites: Speed of tide and habitat type always important across 6 tidal sites



Active + passive acoustics + cameras

Integration of systems that work in high energy sites

+

+

active acoustics use tracking routines

detection of animal noise / animals wearing pinging tags from **passive acoustics**

trigger **camera systems** for identification of real collisions (or not)

OUTCOME: collection of workable amount of data over extended time periods

Globally Shared data bases?

TETHYS tethys.pnnl.gov

- Models to follow?: MEDIN (initiated 2008)

- Locational based: Oceanographic BODC
- Species specific: JNCC seabirds: location of colony, range of population variables
- Type of information specific: Tagging oriented

Communities /Stakeholders

- What sort of information do the wide range of stakeholders really want/need ?
- What types of information and interaction will allow joint understanding of issues

Regulators

Developers

Rural committees

Fisherman

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Conclusions .

- We need to understand at a mechanistic level what animals are doing in high energy sites
- We need to focus on hypothesis driven date collection that feeds the critical/sensitive parameter estimates into individual, population and ecosystem models.
- We need to consider the wider cumulative effects of combinations of offshore energy development and compare to effects of climate change
- We need to work together at data sharing and understanding of needs of entire range of stakeholders.