Seabird habitat models to assess the population effects of displacement

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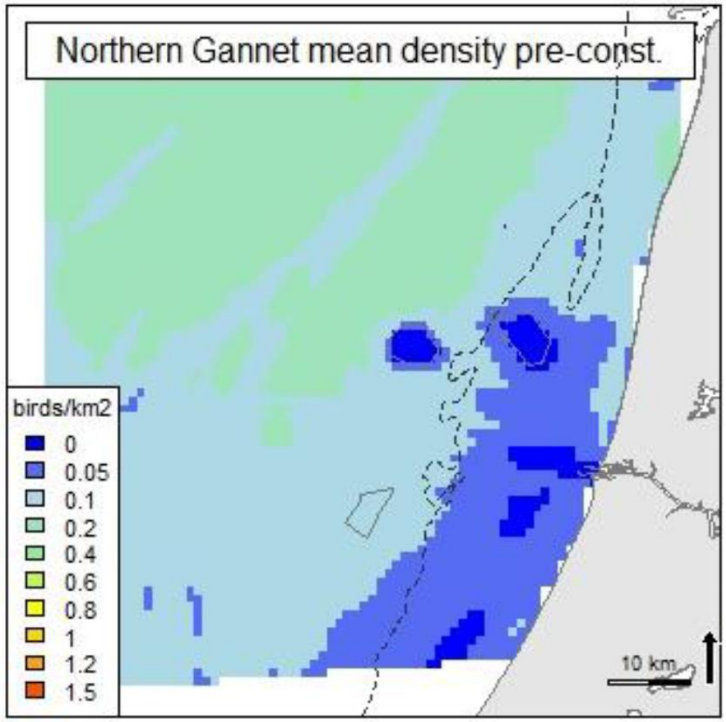
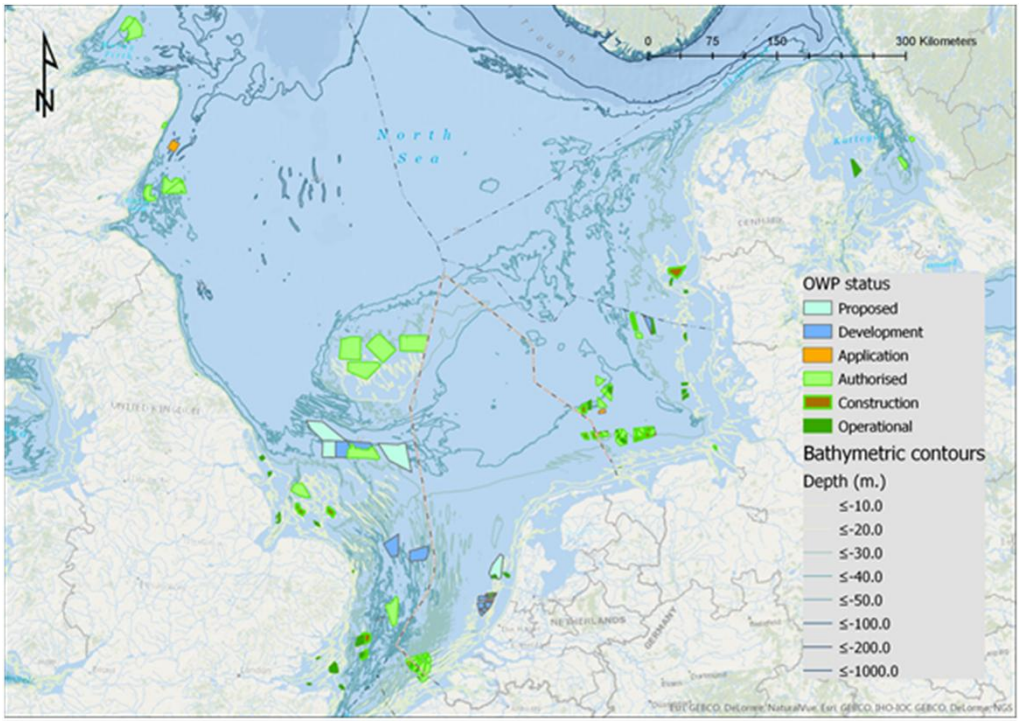
WOZEP
DUTCH GOVERNMENTAL OFFSHORE WIND ECOLOGICAL PROGRAMME

Displacement & habitat loss





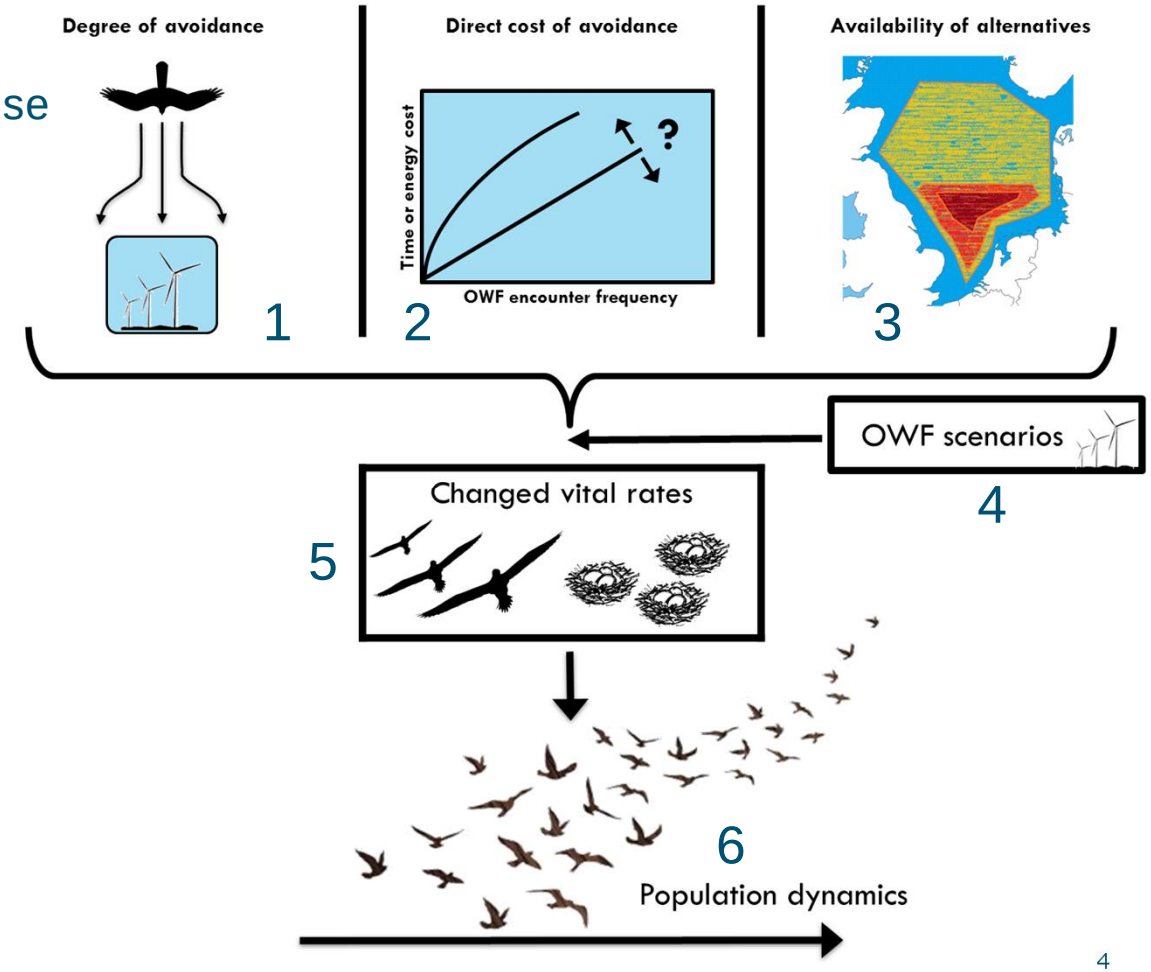
Skov et al. 2016

Project assignment

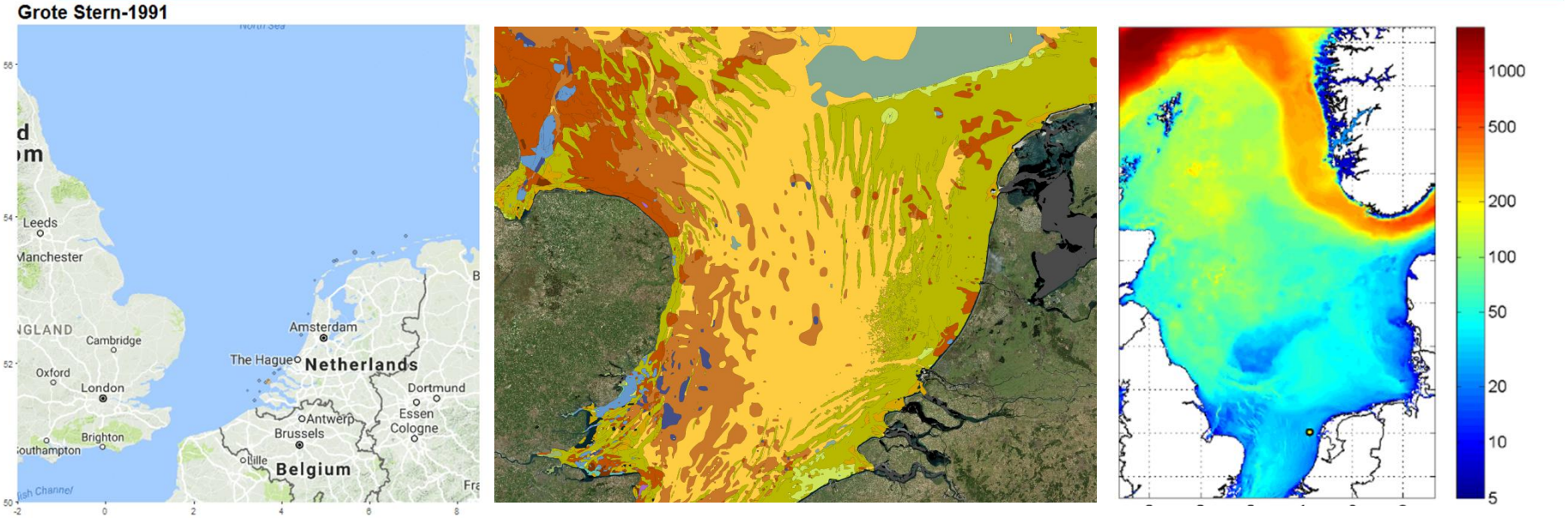
- Develop a framework to assess the effect of Dutch Offshore wind farms, and apply it to populations of
    1. Red-throated diver (*Gavia stellata*)
    2. Northern gannet (*Morus bassanus*)
    3. Common guillemot/murre (*Uria aalge*)
    4. Razorbill (*Alca torda*)
    5. Sandwich Tern (*Thalasseus sandvicensis*)

- Species selected for sensitivity, occurrence and relevance to Dutch policy

1. Individual behavioural response
2. Individual energetics
3. Habitat model
4. Spatiotemporal scenarios of anthropogenic disturbance
5. Individual-based simulation model
6. Matrix population model



Habitat model – 1st focus on Sandwich Tern



Habitat model is a statistical relationship between birds and other, known, factors
Can be used to generate maps of predicted bird occurrence in space if other factors are known

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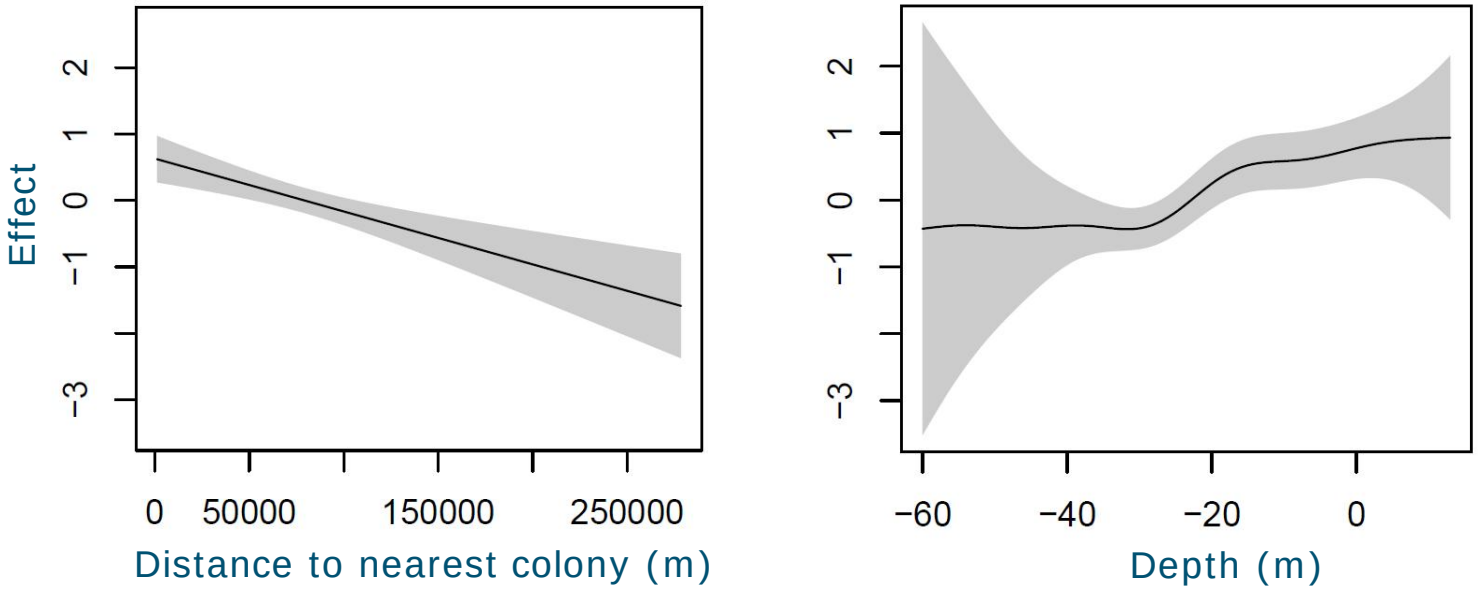
Habitat model – first preliminary results

- Two-step model:
  - Model 1: predict presence/absence
  - Model 2: predict abundance given presence
- For both steps, all factors contribute to explaining the data:
  - Presence ~ year, season, depth, distance to colony, lat/lon, sampled surface
  - Abundance ~ year, season, depth, distance to colony, lat/lon

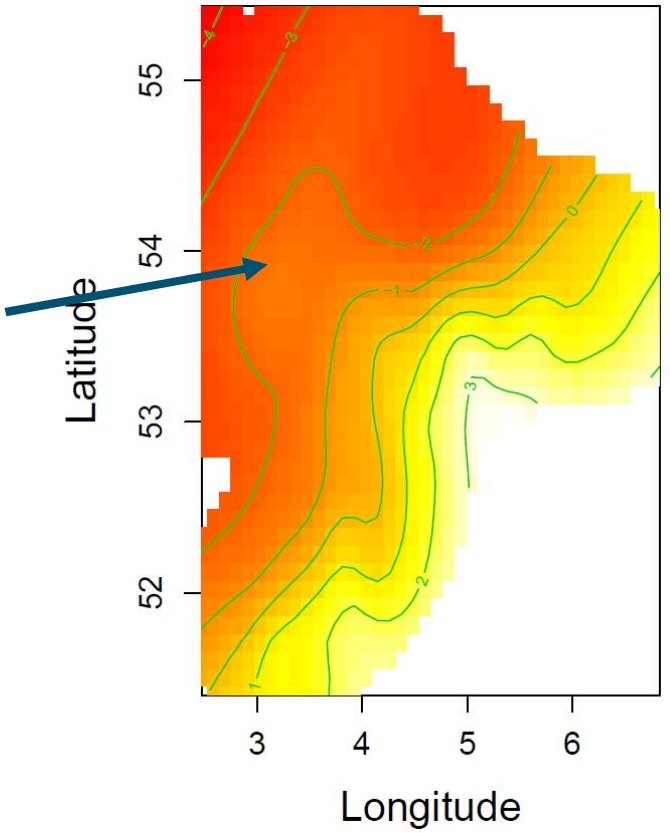
Habitat model – first preliminary results

- Model 1: predicted chance to encounter birds



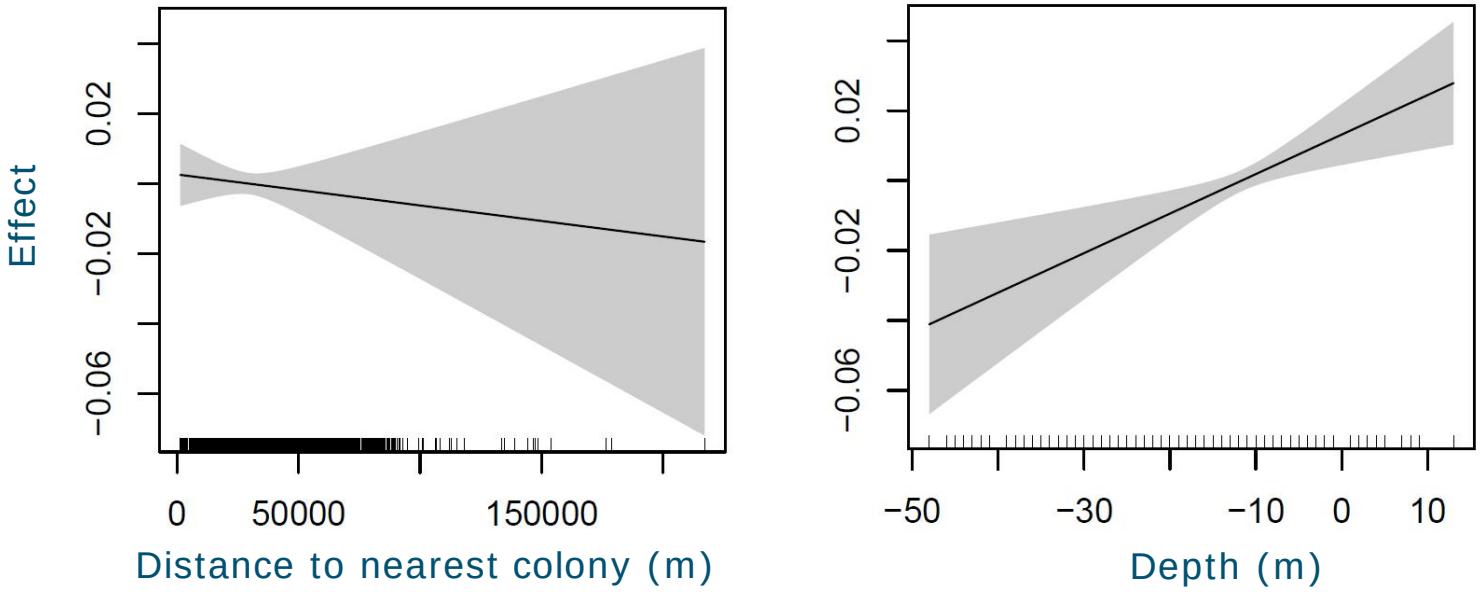
Habitat model – first preliminary results

- Model 1: predicted chance to encounter birds
- Still substantial variation in ‘spatial smoother’ not caught in depth/sediment/distance to colony
- Perhaps necessary to include British breeding colonies



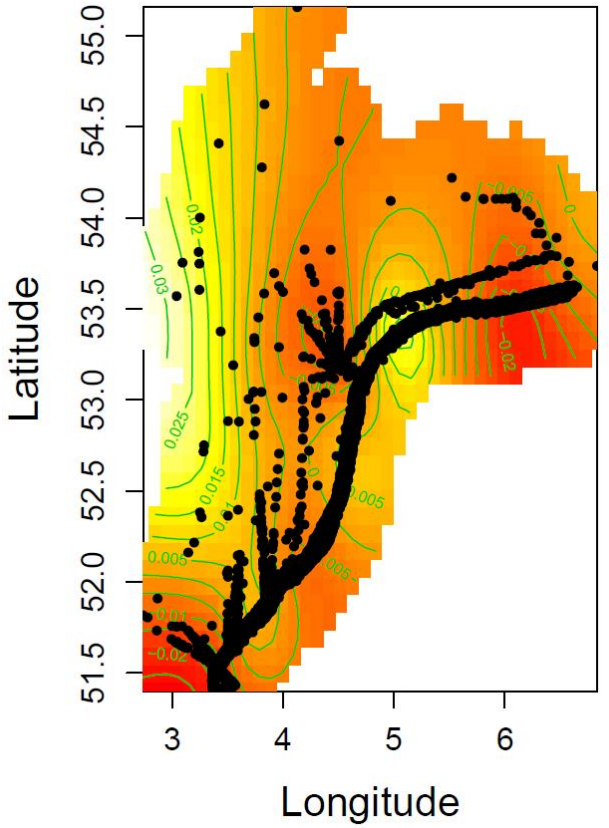
Habitat model – first preliminary results

- Model 2: Bird density given presence

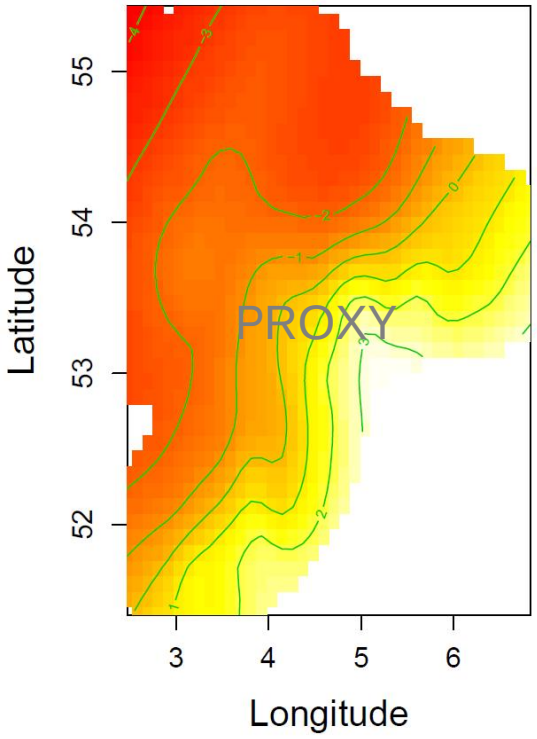


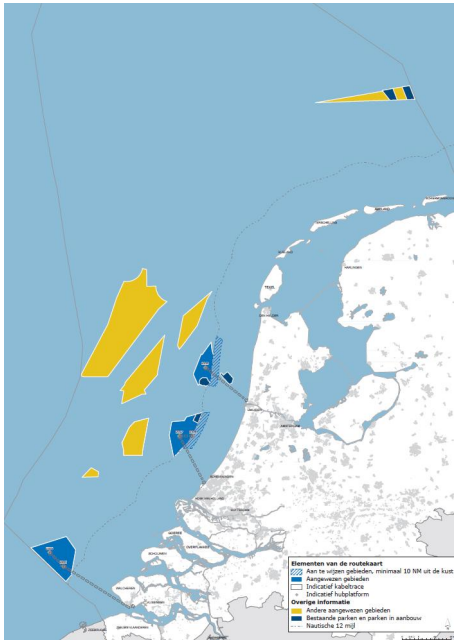
Habitat model – first preliminary results

- Model 2: Bird density given presence
- Here also: unexplained heterogeneity
- Again, an effect of British birds?



Effects of OWF scenarios





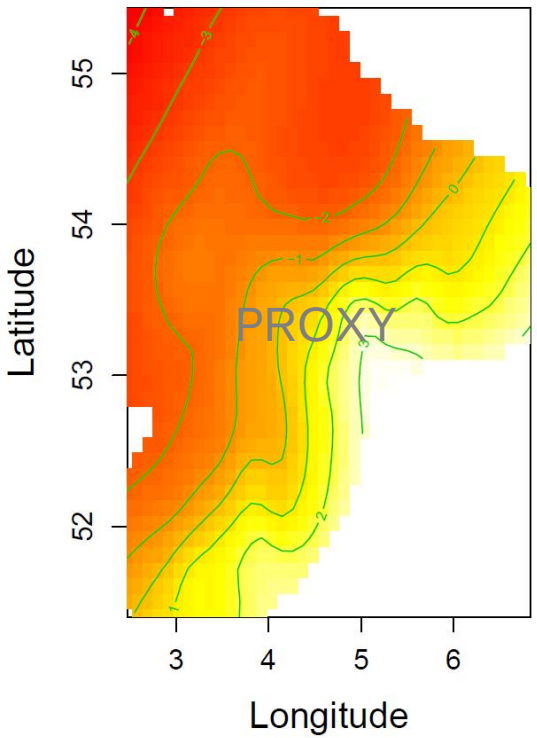
Overlap shows the degree of habitat loss

But how to translate this to population-level parameters?

-> Simulation model

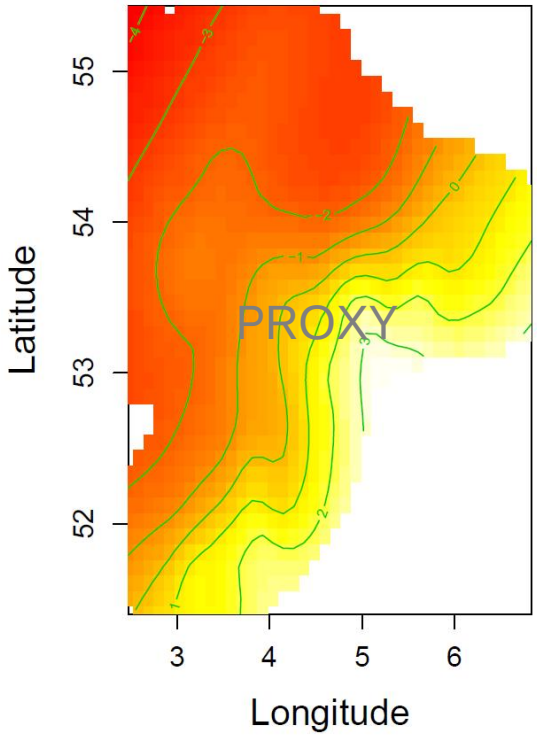
Individual-based simulation model

- Simulate large number of individuals, in absence of OWF, ‘flying around’ on map
- Using simple behavioural rules
- Each with a simple energy budget:
  - $E_{t+1}=E_t+I_t+M$
- Assume that E=0 means death
- Use habitat quality at location as estimate of intake.
- Annual survival = #at start/#at end
- To calibrate: tune M to known survival



Individual-based simulation model

- Once calibrated, implement OWF scenario
  - Set OWF areas
  - Set degree of avoidance
- Difference in annual survival = effect on population parameter



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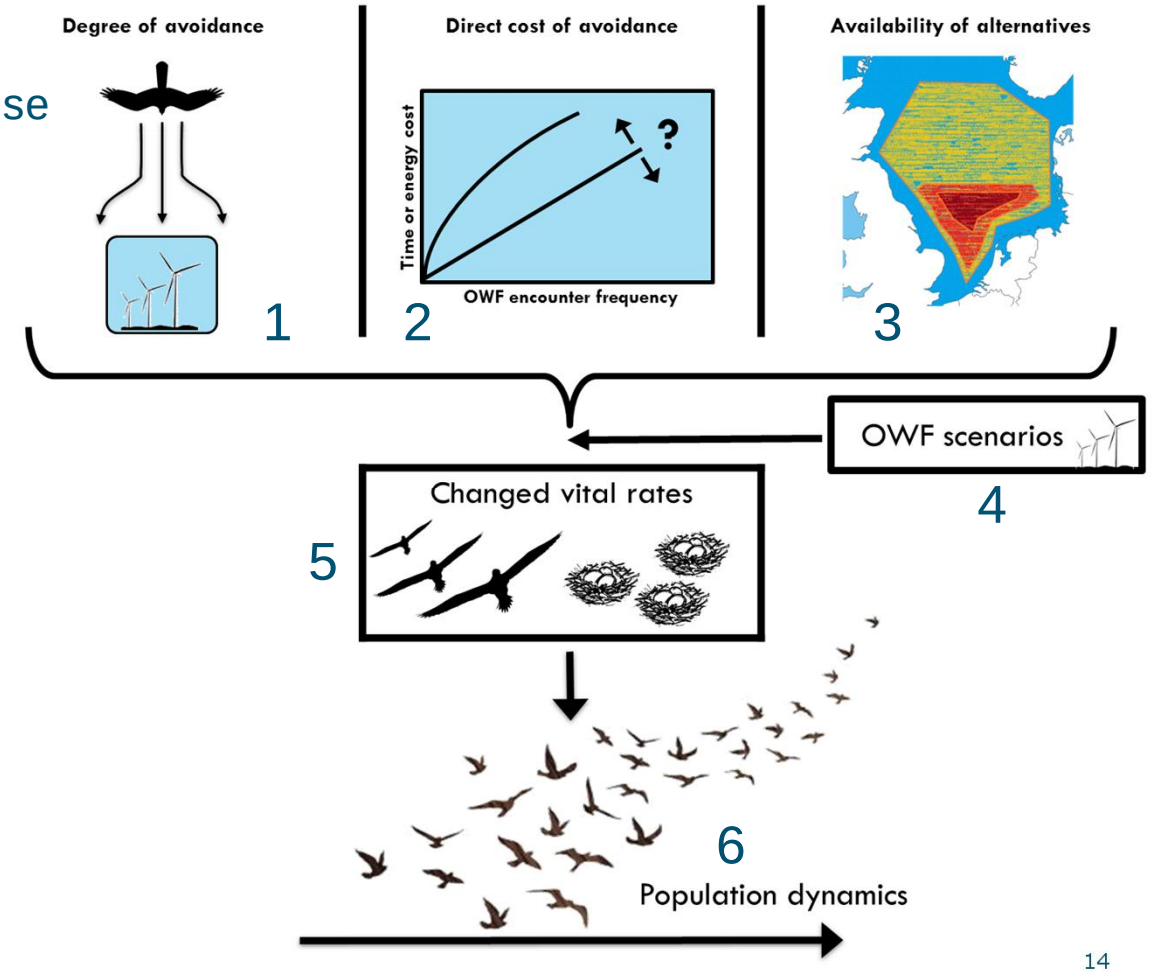

Questions!

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