SCIENCE FOR THE ENVIRONMENT CONFERENCE
Aarhus University, Denmark
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Biodiversity over the horizon: modelling marine waterbird abundance in inner Danish waters

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Offshore waterbirds in Denmark

• Denmark's inshore waters are winter home to well over 1 million divers, grebes, seaducks and auks and make a global contribution to biodiversity reflected in site-safeguard designation in offshore waters

• These are amongst the most spectacular aggregations of such birds in the world, giving Denmark special responsibility (under international legislation) for the protection of these stocks and the habitats upon which they rely

Monitoring waterbirds in Denmark

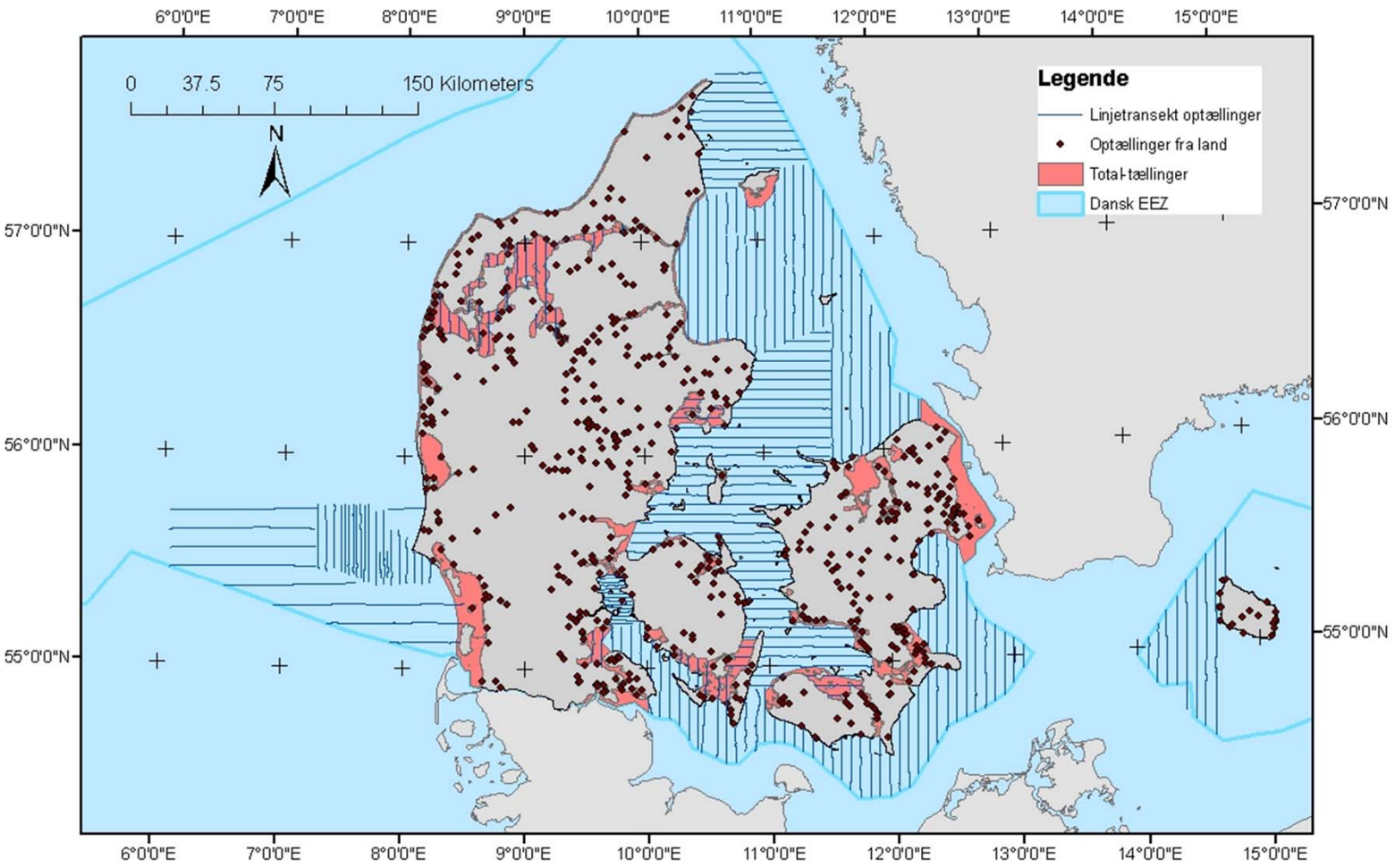
• Midwinter surveys of waterbirds are carried out every 3 years in January to provide a national inventory of wintering waterbirds in Danish waters

• These are part of the NOVANA programme, partly to report on waterbird abundance within the Danish EU SPA and RAMSAR protected site networks

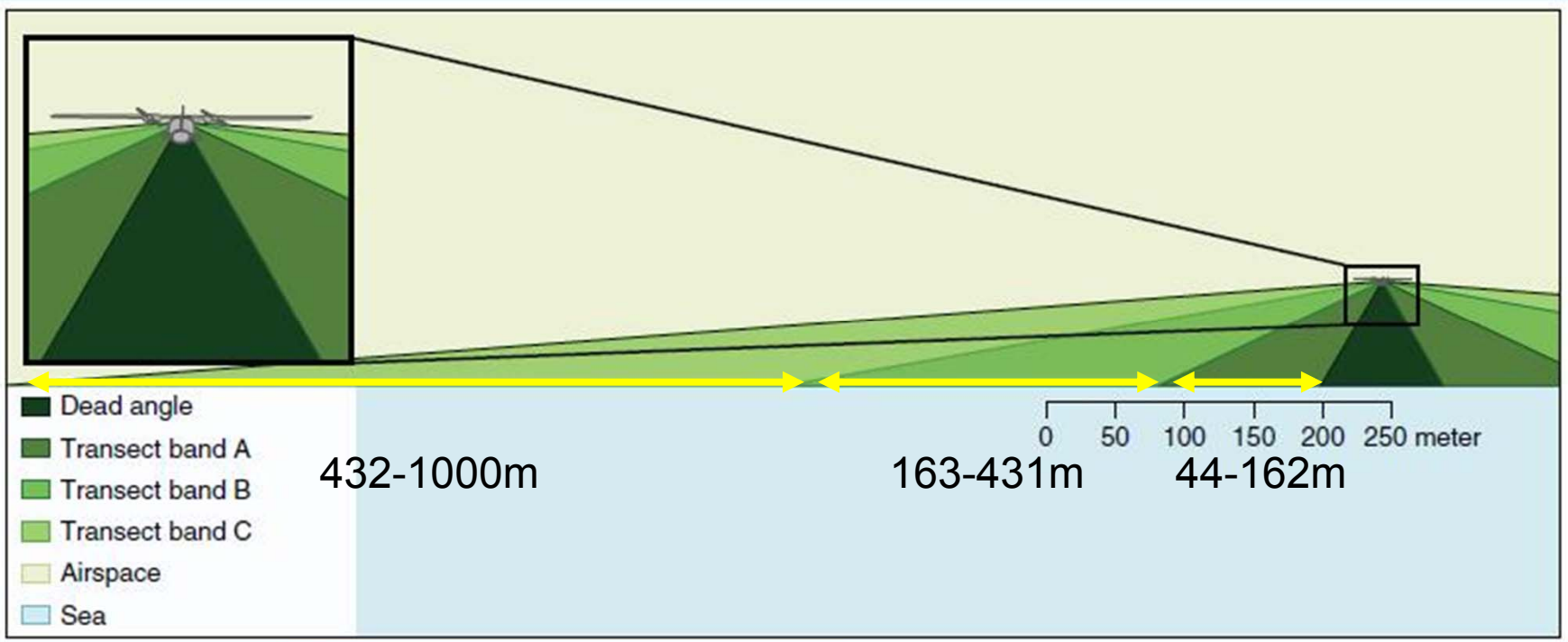
• The vast majority of the inner Danish waters are covered using aerial surveys, and only a restricted part of the Danish North Sea is surveyed, while numerous inland and coastal wetlands are surveyed using ground observers.

• These surveys also compile information changes in the number and distribution of wintering waterbirds in Denmark to compare with data from 1969-1973, 1987-1992, 2000, 2004 and 2008.

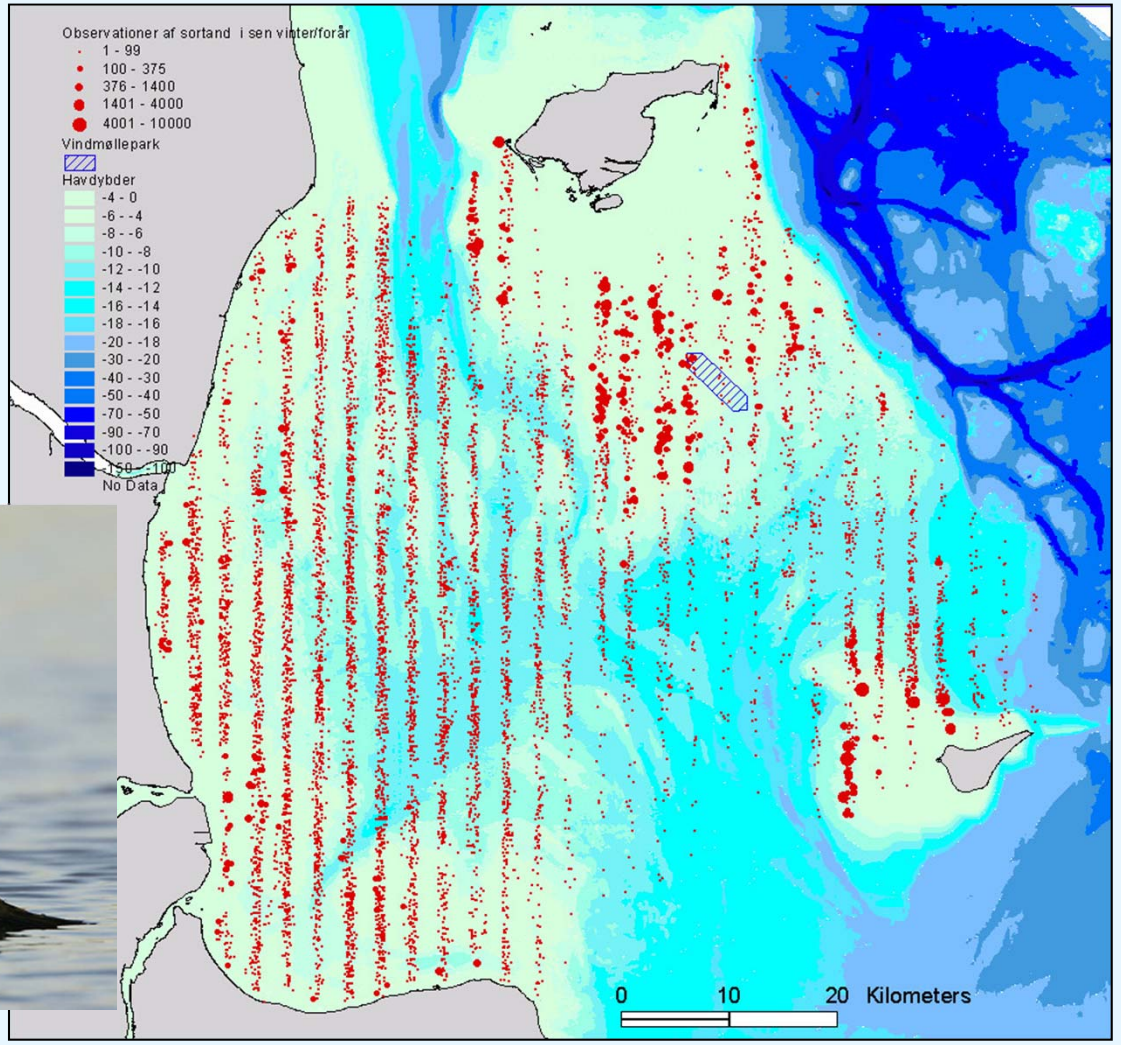
National midwinter survey of 2008



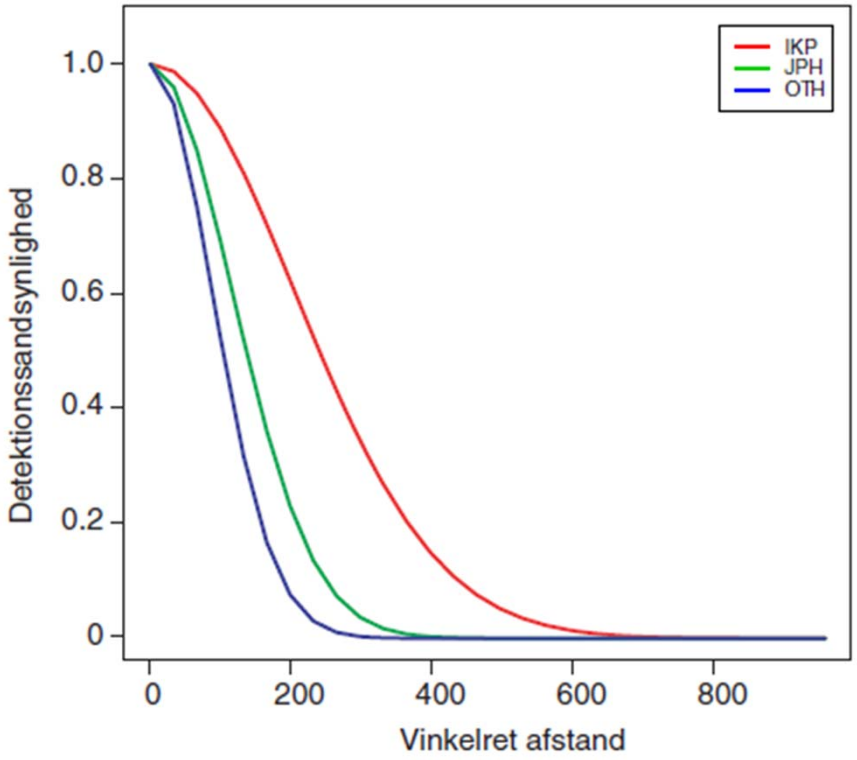
Survey techniques



Species distribution maps

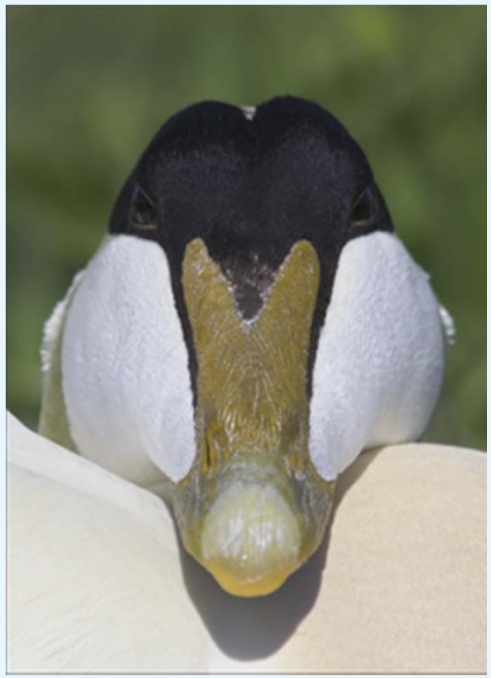


Distance sampling: fitting a detection function

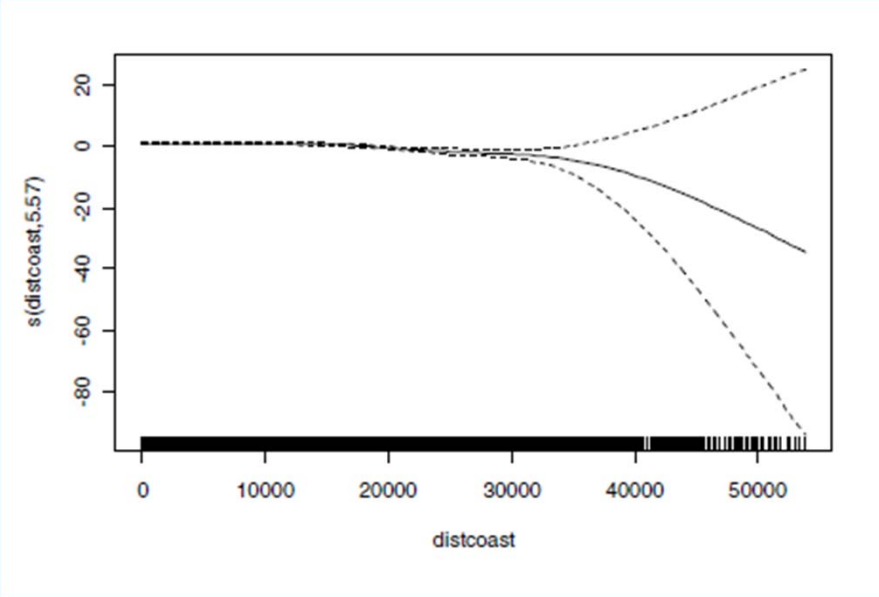


9	none	hazard rate	388.0156	9637.616	21.93224	18.98075	25.34267	0.07384
33	sea state, log cluster size, behaviour	half normal	423.8652	9673.466	14.68936	12.94793	16.66501	0.06444
21	sea state, log cluster size	half normal	432.583	9682.184	14.64995	12.92173	16.60931	0.06411
29	log cluster size, behaviour	half normal	434.4893	9684.09	14.52593	12.82712	16.44973	0.06352
16	log cluster size	half normal	441.3359	9690.937	14.49091	12.808	16.39496	0.06304
23	sea state,behaviour	half normal	642.7754	9892.376	19.49847	16.83816	22.5791	0.07494
12	sea state	half normal	642.8311	9892.432	19.3871	16.76927	22.4136	0.07411
10	none	half normal	655.6523	9905.253	19.16073	16.61678	22.09414	0.07277

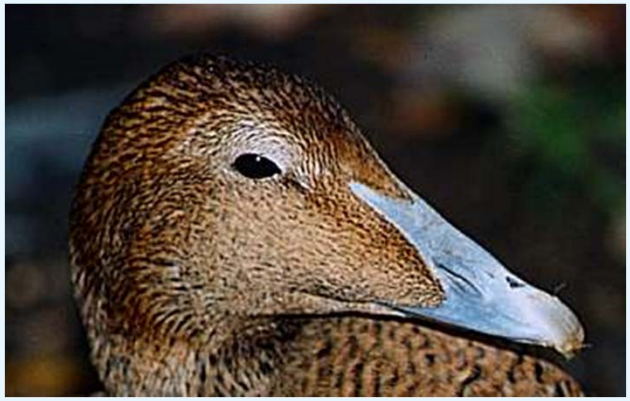
- Distance to object
- Observer
- Cluster (=flock) size
- Behaviour (swim/fly)
- Sea state

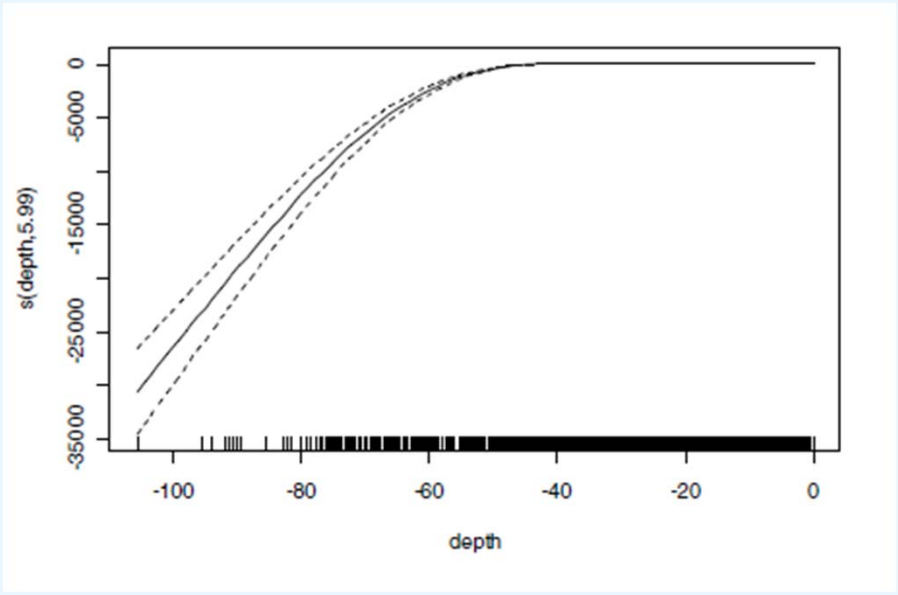


Spatial modelling: modelling densities using environmental parameters and GAMs

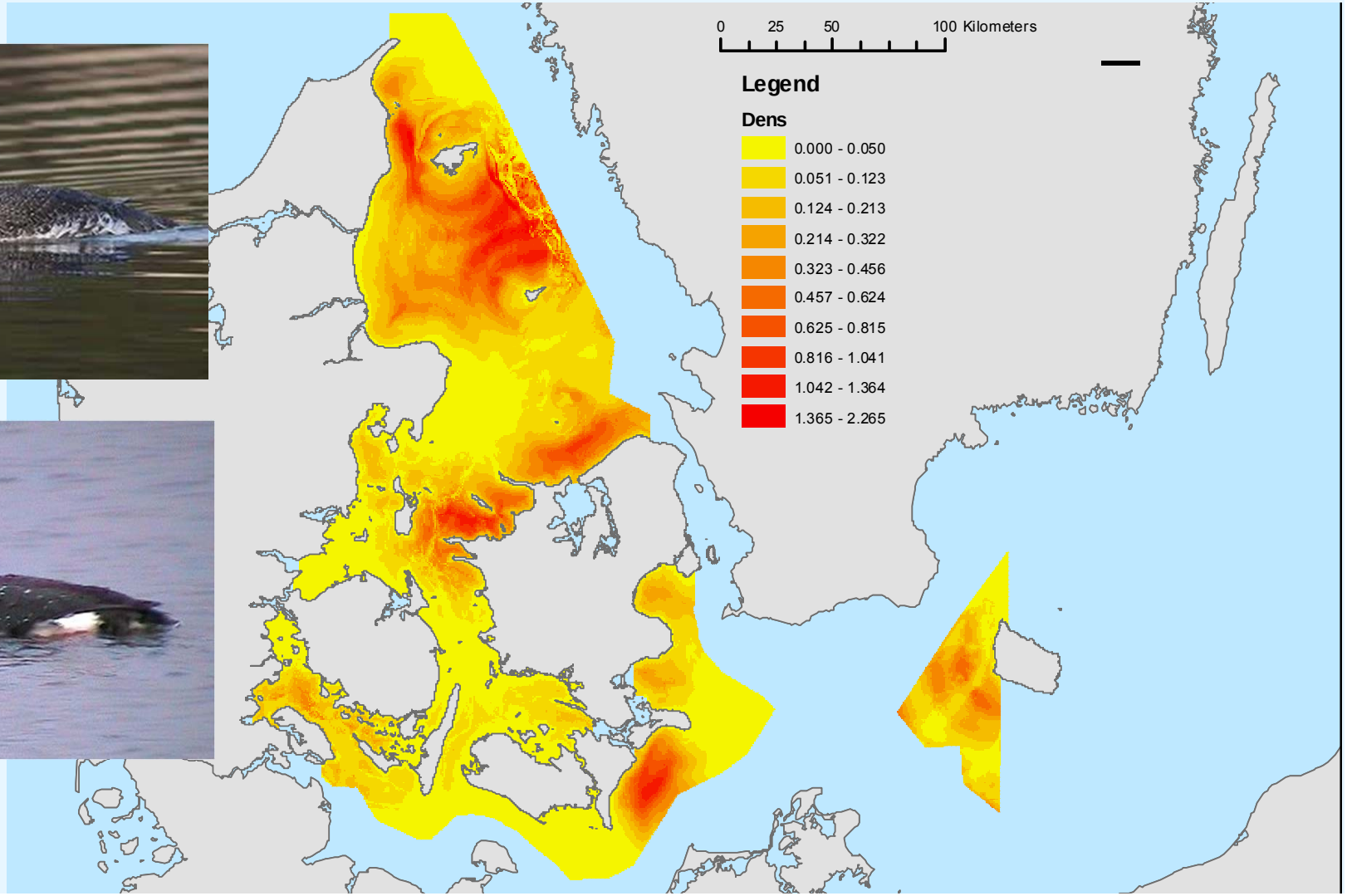


- Latitude
- Longitude
- Distance to coast
- Water depth

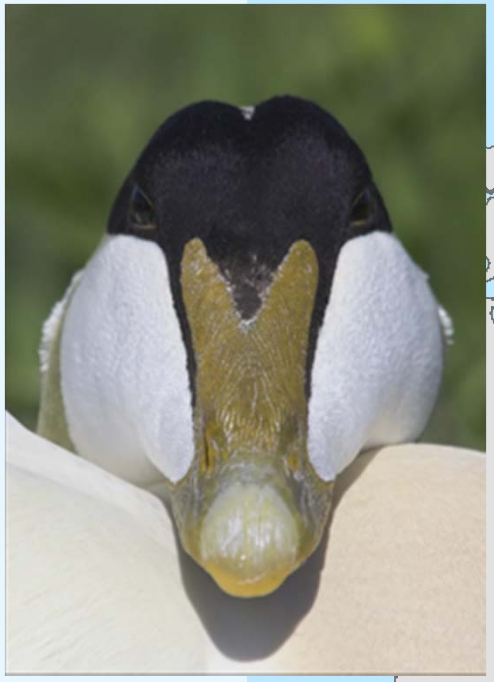




Winter distribution of Divers



Winter distribution of Common Eider



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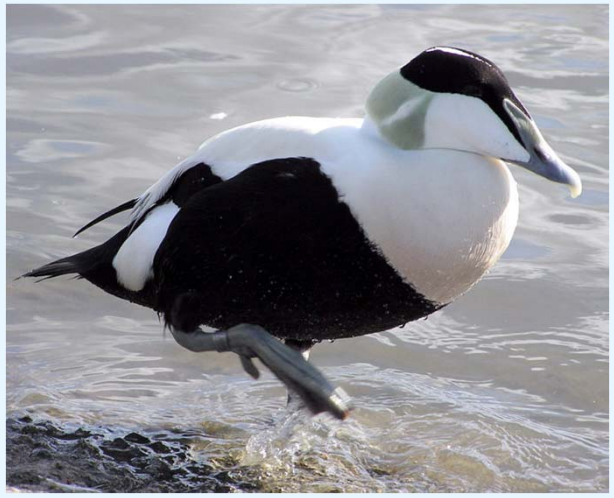
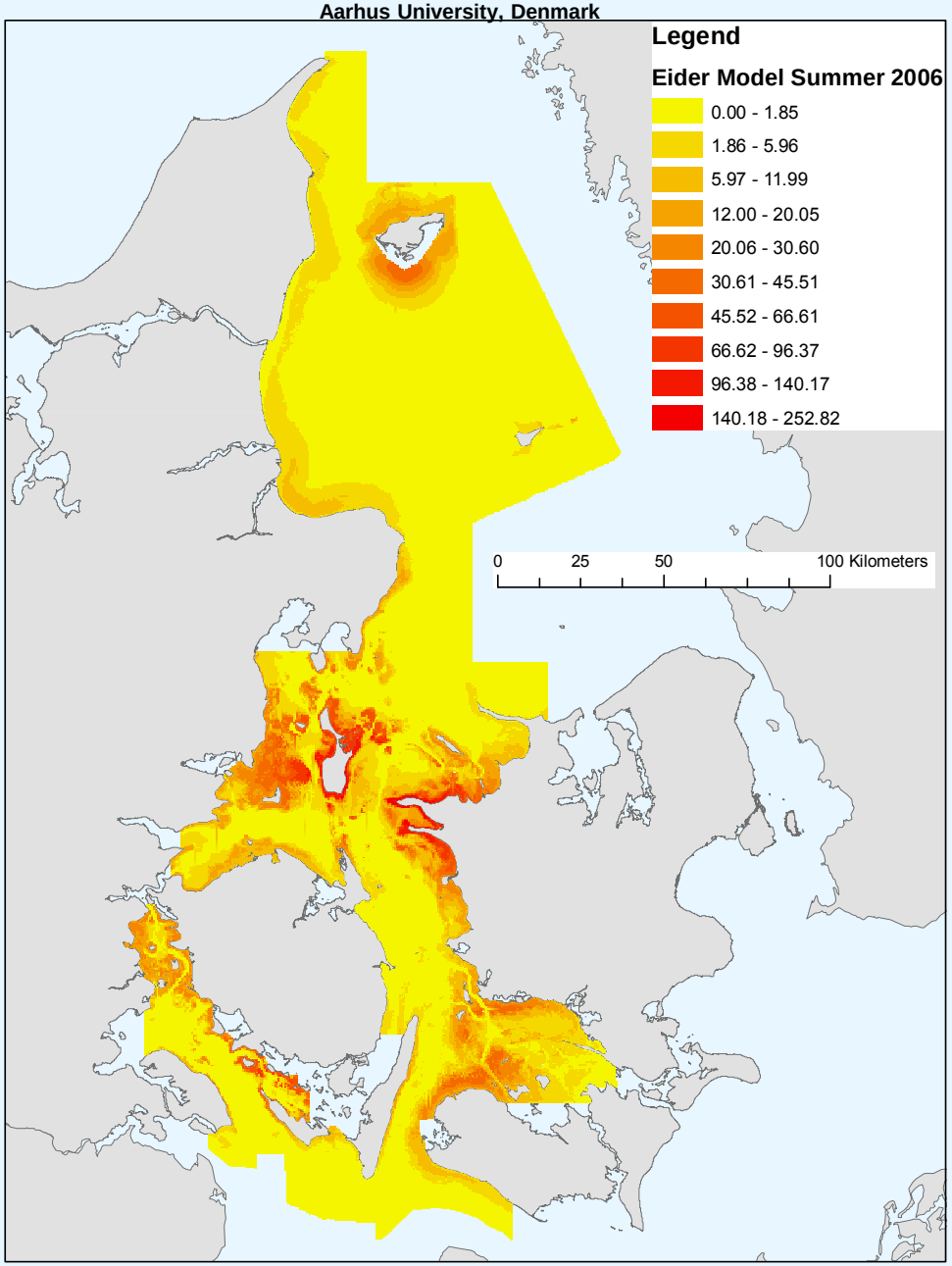
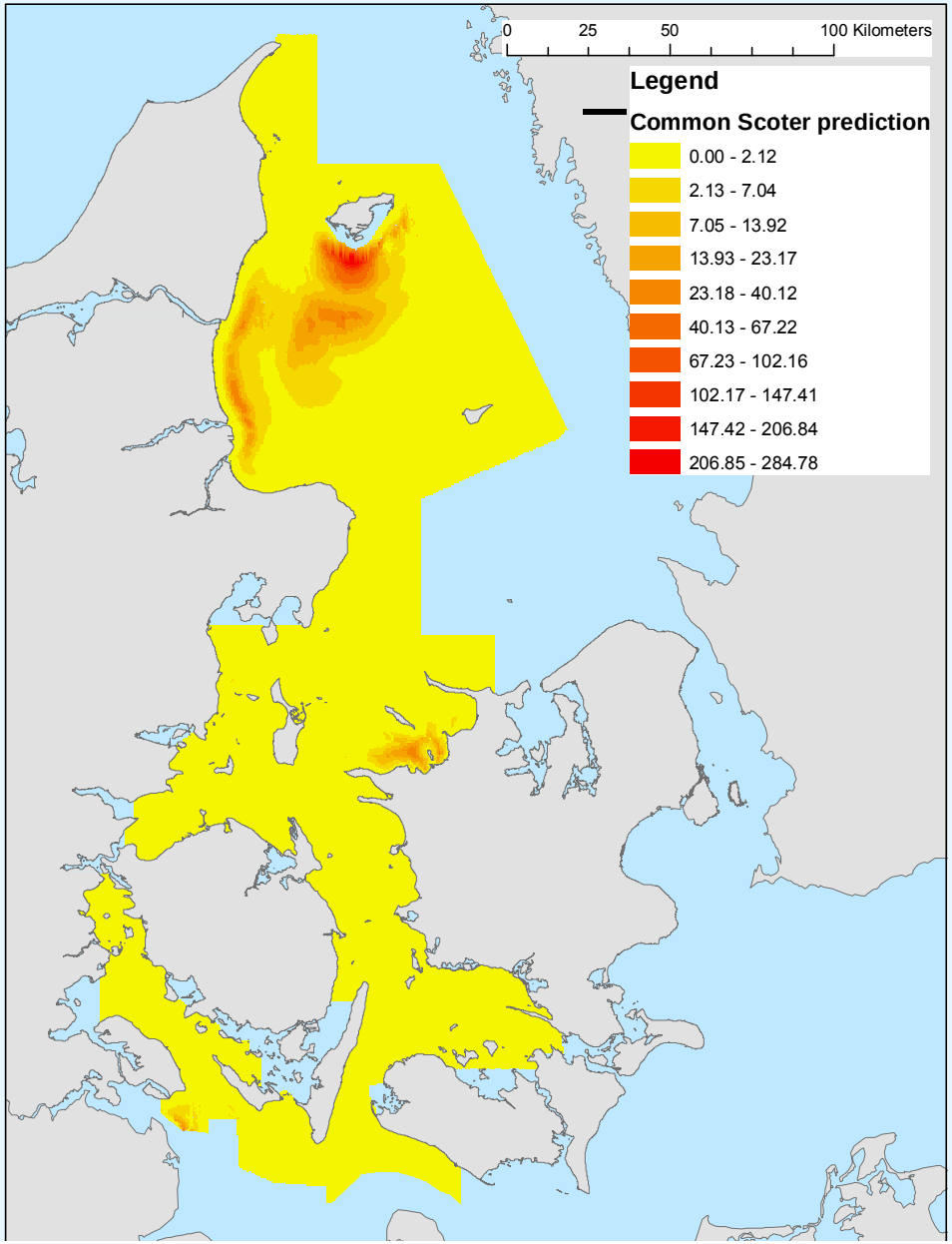
Summer (2006) Distribution of Common Eider



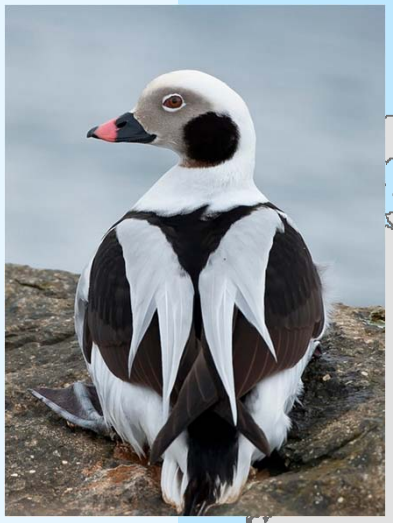


Winter distribution of Common Scoter

Summer (2006) Distribution of Common Scoter



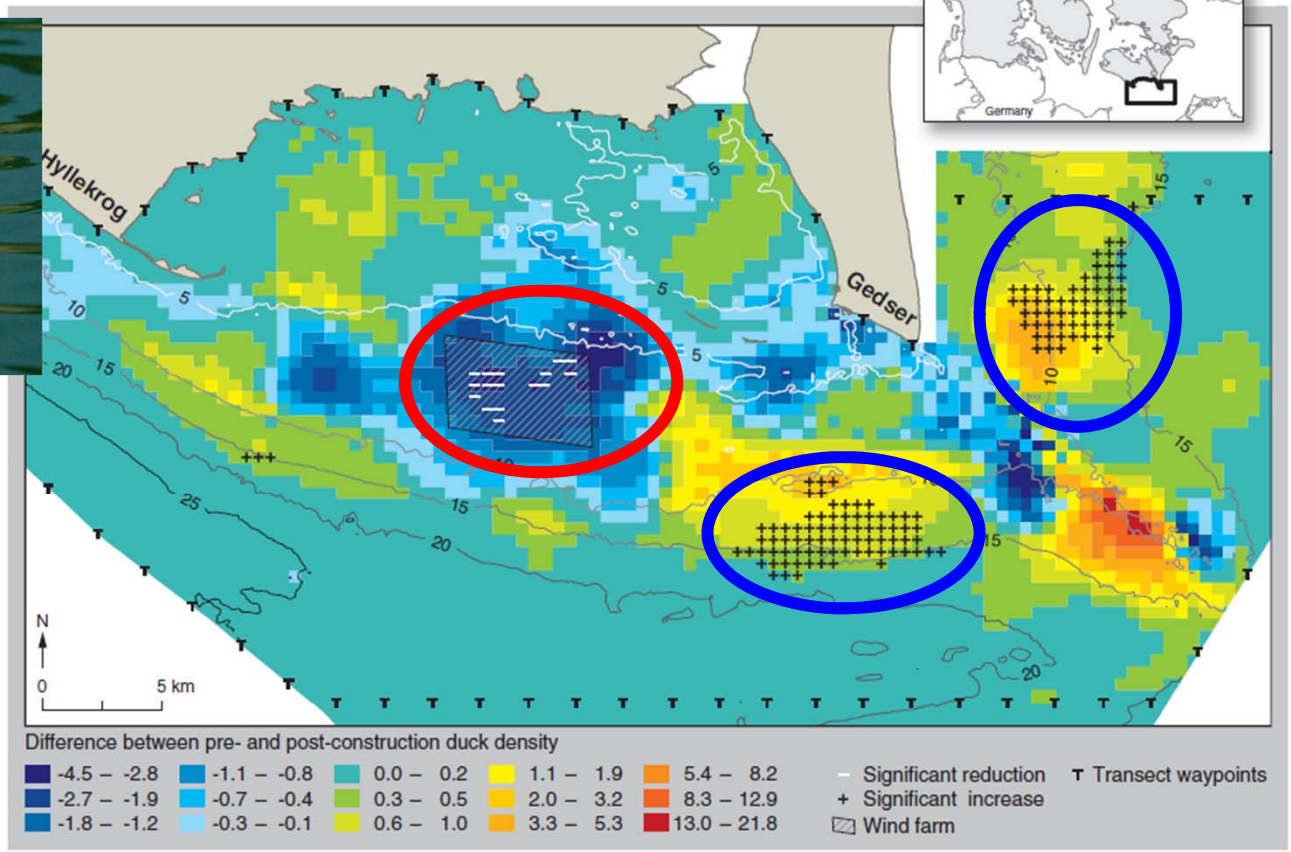
Winter distribution of Long-tailed Duck,



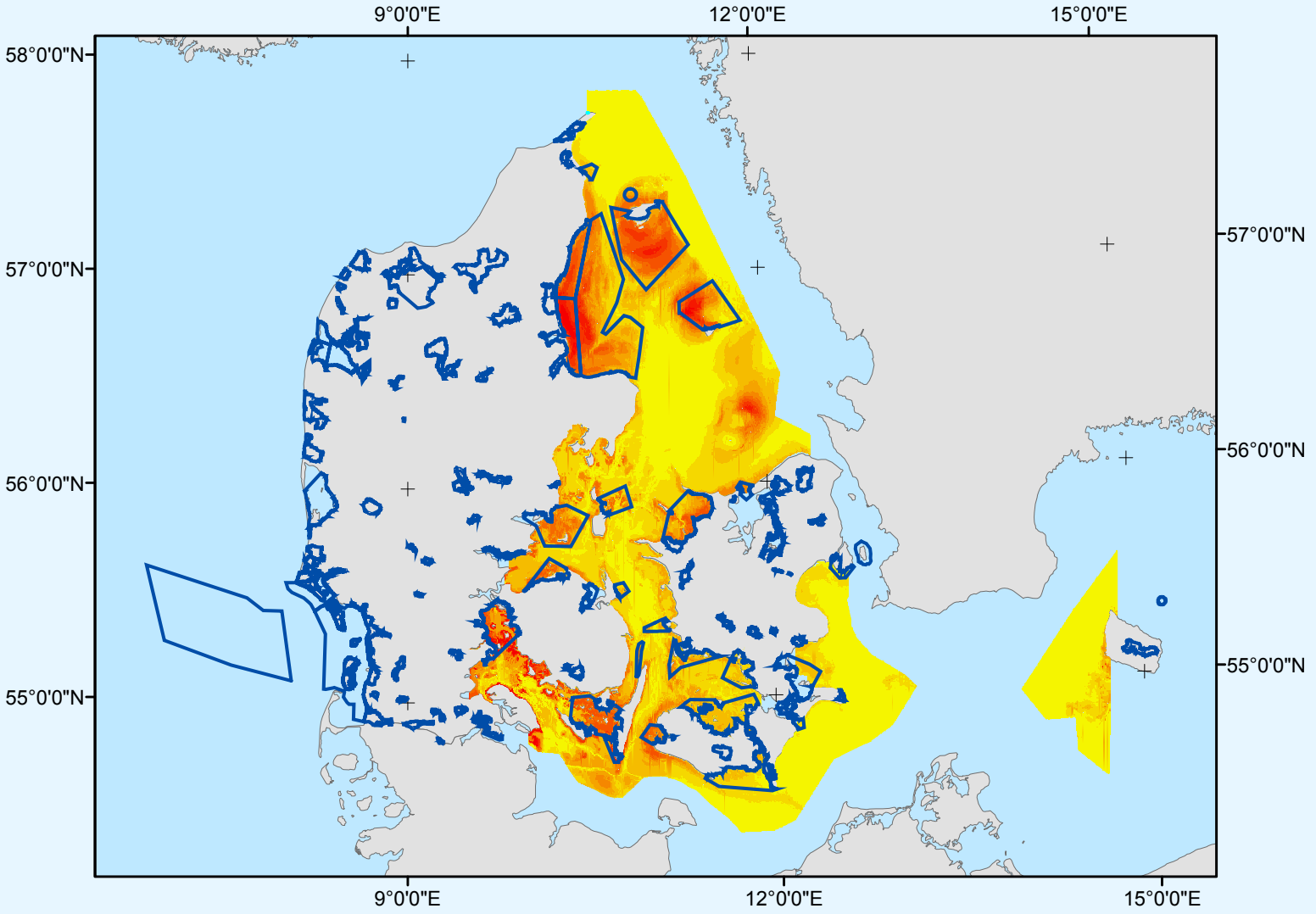
Winter distribution of Red-breasted Merganser

Winter distribution of Razorbill/Guillemot

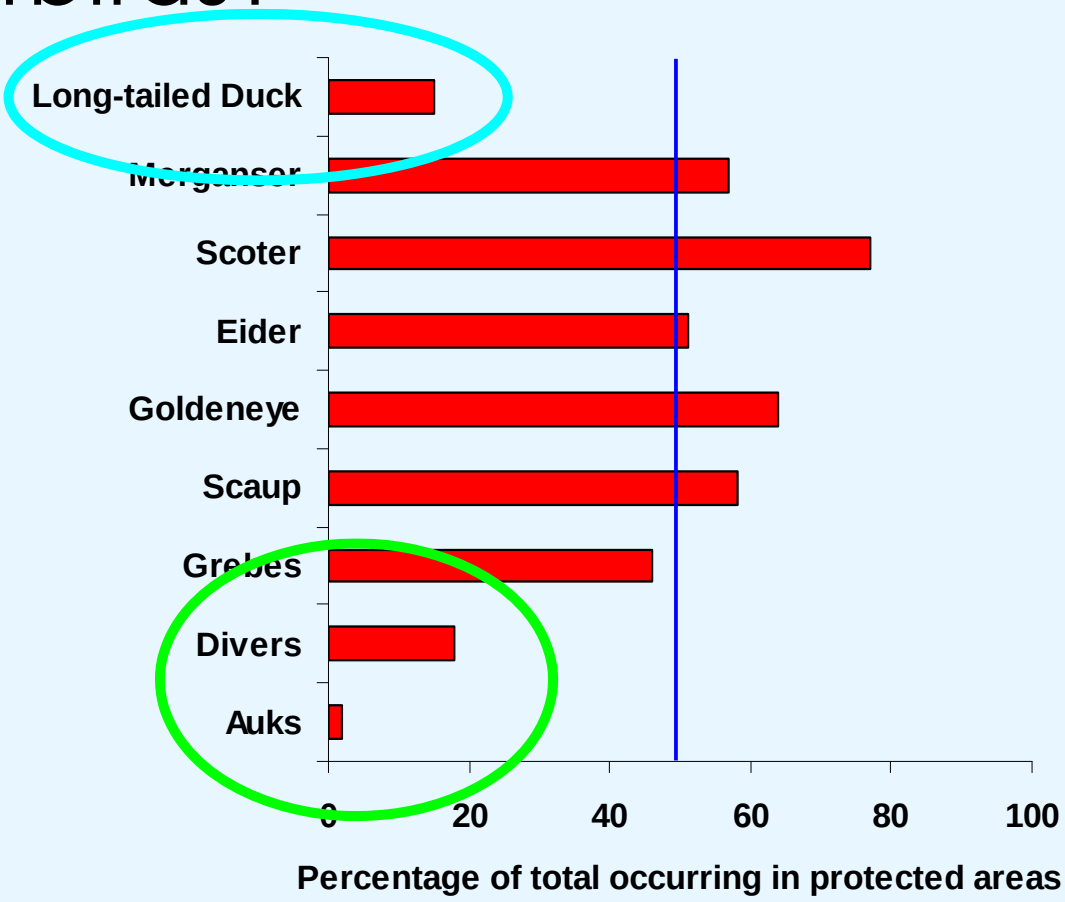
These density surfaces can be used to test for displacement caused by offshore windfarm construction



Cumulative abundance of all species



How good are the Danish site safeguard networks at protecting offshore waterbirds?



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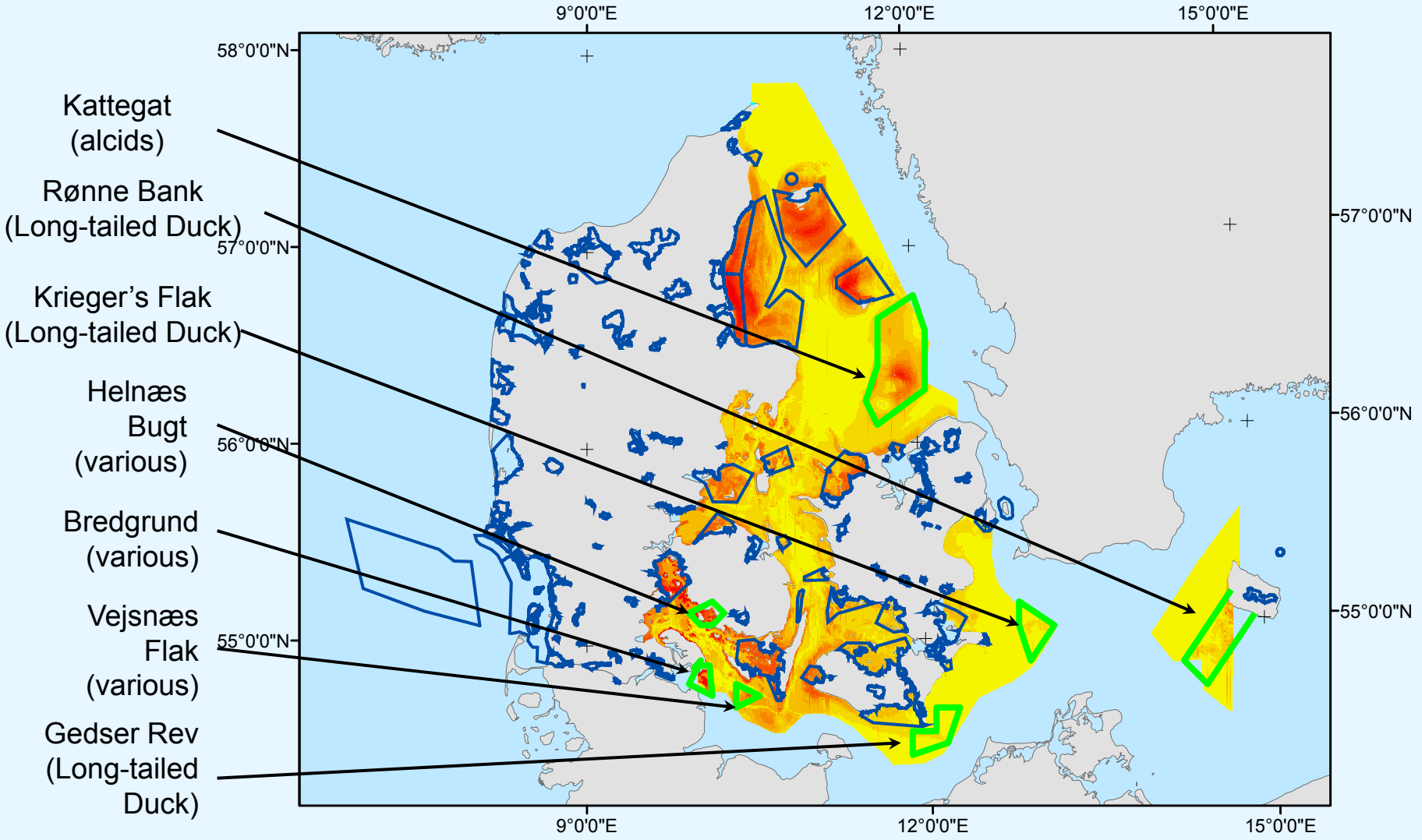
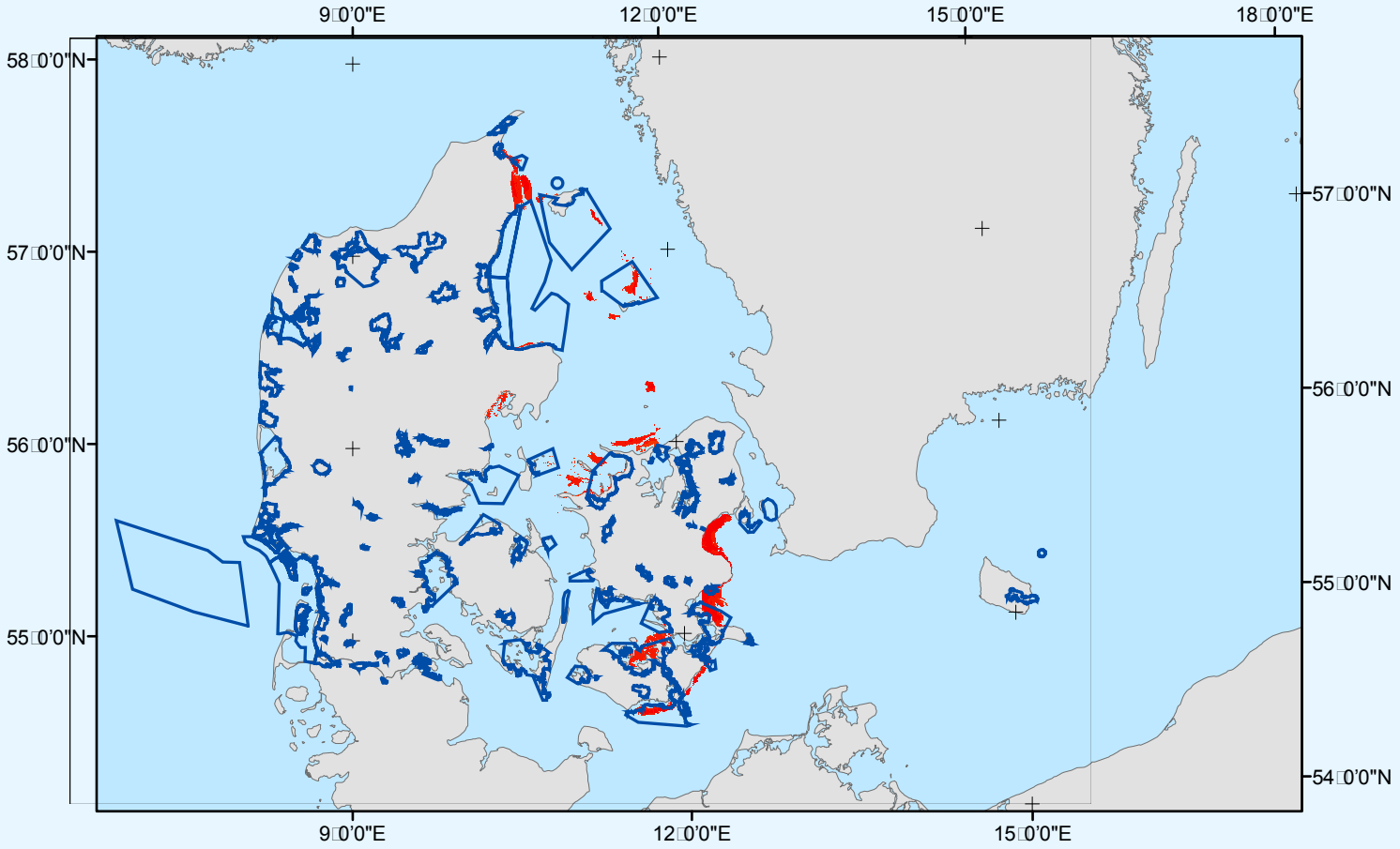


Diversity hot spots (Shannon Index>0.75)



Overview

Densities modelled on midwinter bird surveys in Inner Danish waters in 2008 were:

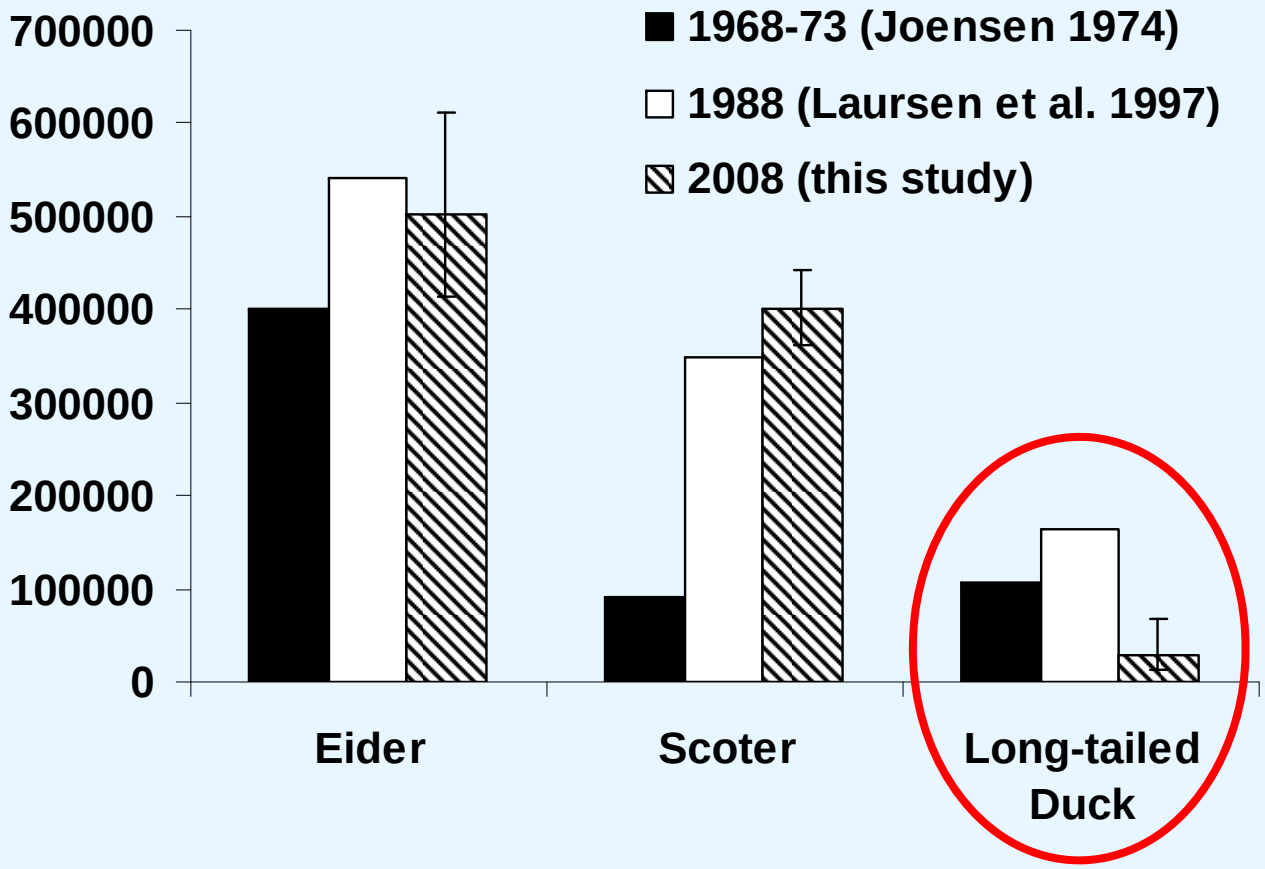
- 6,000 divers (Red and Black-throated, but almost all the former)
- 630,000 Common Eider
- 401,000 Common Scoter
- 28,300 Long-tailed Ducks
- 21,000 Red-breasted Mergansers
- 76,600 auks (Razorbills and Guillemots)

- Considering the SPA/Ramsar network was designated in the 1980s, when survey techniques made it very difficult to carry out surveys offshore, the site safeguard programme implemented then by the Forest and Nature Agency covers the present offshore bird interest remarkably well

- The results of the 2008 survey have proved extremely powerful in confirming that the current SPA/Ramsar network covers the majority of wintering offshore bird concentrations and provides guidance for potential future extensions to cover inadequacies (particularly for auks and Long-tailed Ducks).

Historical overview

Modelled densities (± 95% CI) in 2008 generally compared favourably with earlier surveys in 1968-73 (Joensen 1974) and 1988 (Laursen *et al.* 1997)



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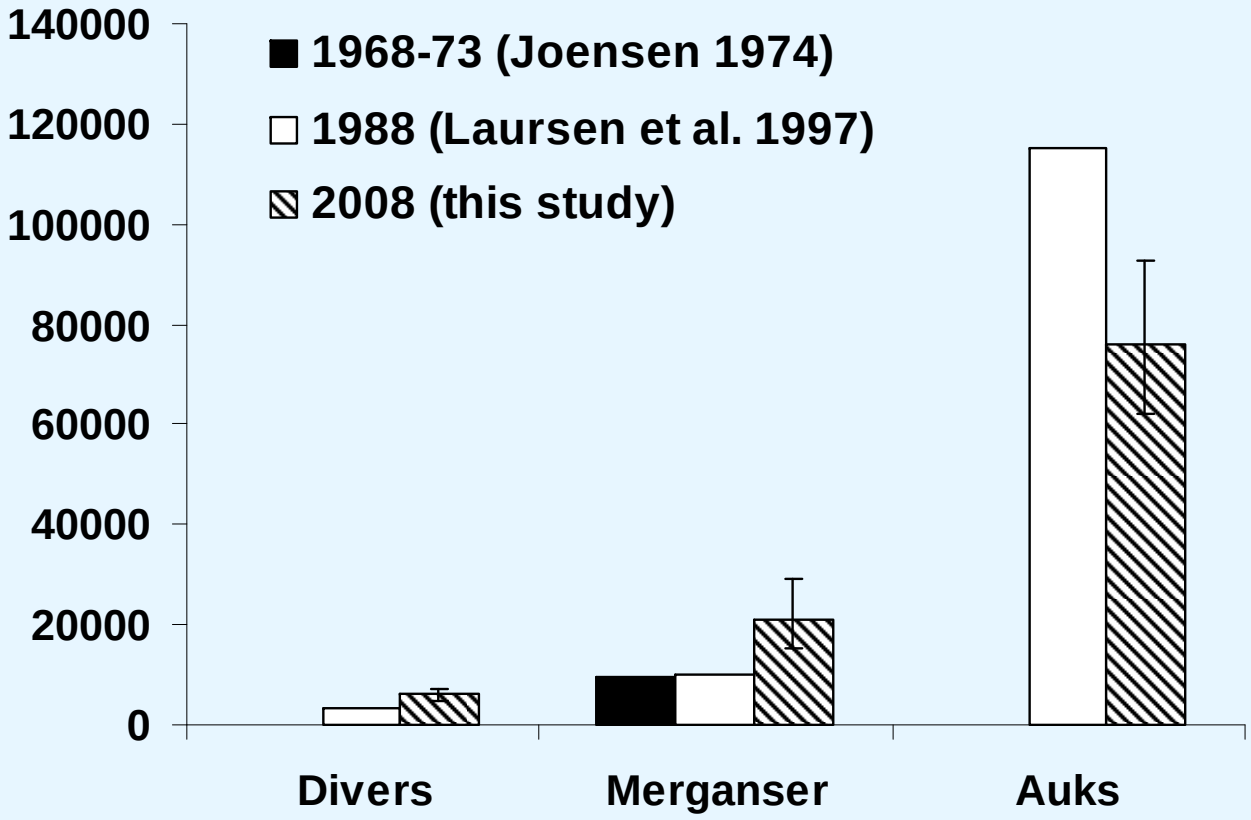
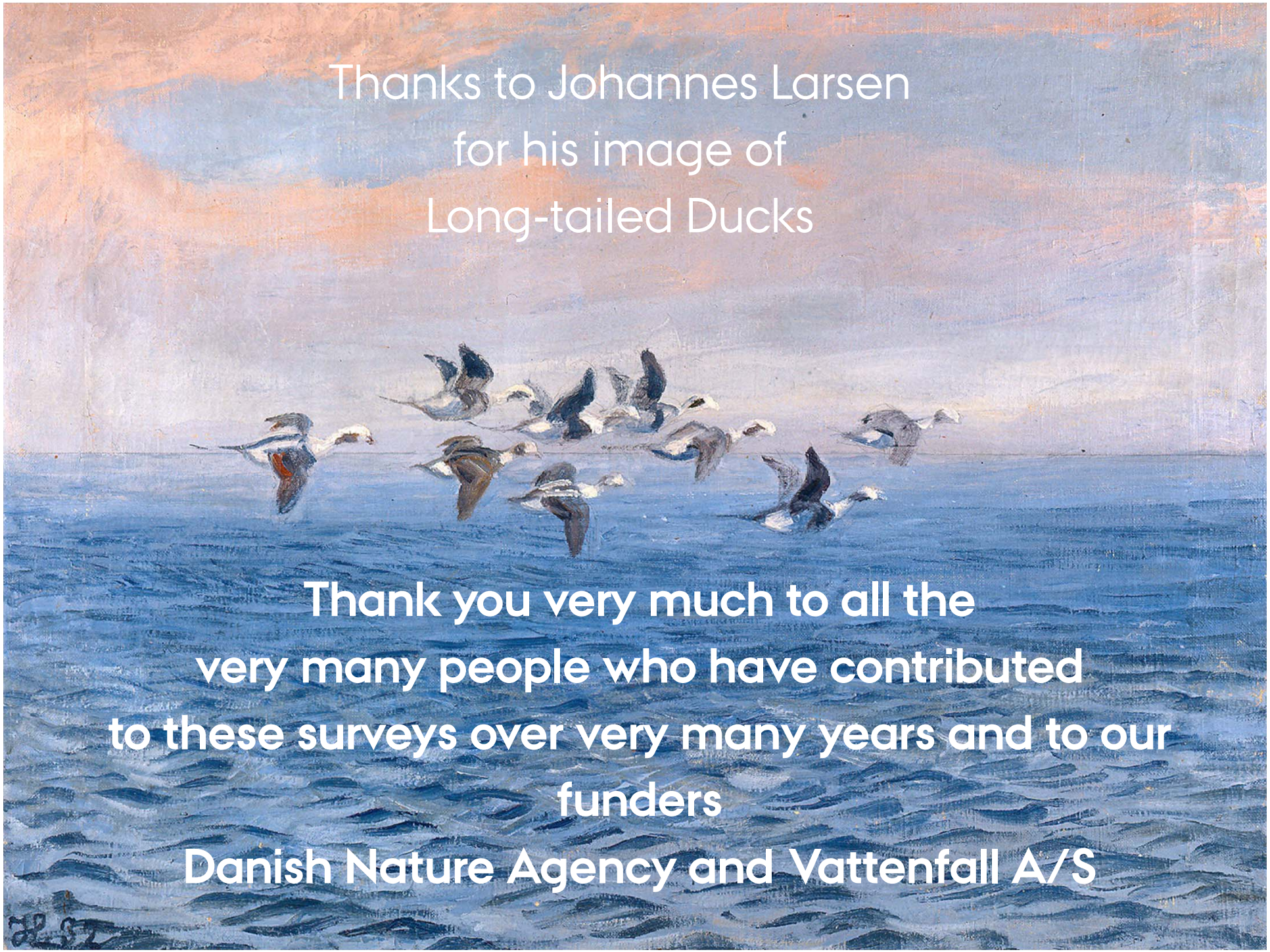


Take home thoughts...

- Very difficult to make direct comparisons between these three major surveys in the late 1960s, late 1980s and 2008,
- Nevertheless, no major signs of very serious decline except Long-tailed Duck, known to have declined throughout the Baltic; Common Scoter and Red-breasted Merganser may have increased; we do not know enough about the divers and Alcids to offer opinions about changes in their abundance
- The SPA/Ramsar site safeguard network implemented 25 years ago gives good provision of protection over areas important for different species today with a few minor exceptions
- Our challenge is now to understand more about process behind the pattern and ensure we can maintain these protected areas in a state that supports these birds now and in the future



Thanks to Johannes Larsen
for his image of
Long-tailed Ducks

**Thank you very much to all the
very many people who have contributed
to these surveys over very many years and to our
funders
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