

# **Environmental monitoring at Nysted and Horns Rev Offshore Wind Farms**

A photograph of an offshore wind farm at sunset. The sun is low on the horizon, creating a bright orange glow and a long, shimmering reflection on the water. Several wind turbines are visible, their silhouettes against the bright sky. A small boat is seen on the right side of the water, moving away from the viewer. The overall scene is serene and atmospheric.

**Charlotte Boesen,  
Energi E2**

**Great Lakes Offshore Gathering for April 4, 2006**

# Agenda



- About Energi E2
- The two wind farms
- The monitoring programme
- Artificial reef effect
- Fish monitoring
- Bird monitoring

# About Energi E2

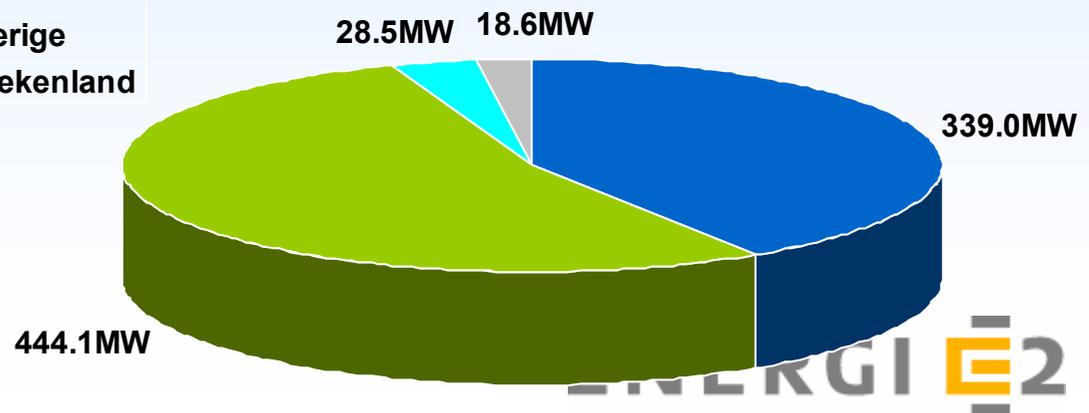
## ENERGI E2 operates

- 619 MW onshore wind (900 turbines)
- 211 MW offshore wind (100 turbines)

## ENERGI E2 offshore

- Vindeby 5 MW
- Middelgrunden 40 MW
- Uttgrunden 10 MW
- Yttre Stengrund 10 MW
- Nysted 165 MW
  
- Projects in UK, Germany, Norway, Sweden, Greece and Spain.

E2 Wind Energy -  
On- and offshore gross capacity (MW)



# Where are we?

- Nysted Offshore Wind Farm
- Horns Rev Offshore Wind Farm



Horns Rev OWF



Nysted OWF



# Nysted Offshore Wind Farm



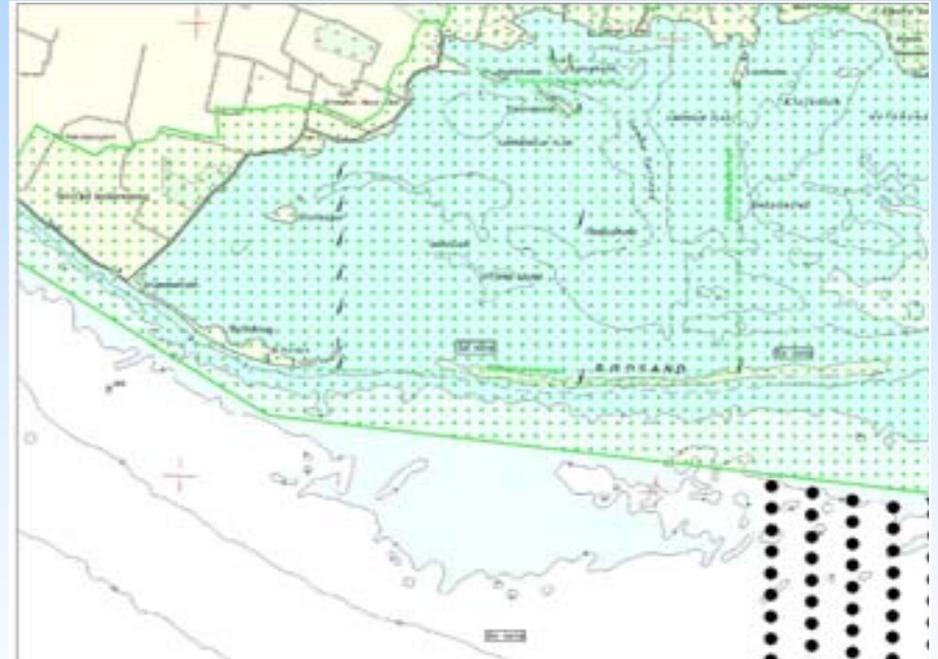
72 Bonus 2,3 MW, 166 MW

Water depth: 6 -10 m

Sediment: Sand on hard clay

Distance to coast: 10 km

Foundation: Concrete caissons



# Horns Rev Offshore Wind Farm



80 Vestas V80 2MW, 160 MW

Water depth: 7 – 14 m

Sediment: Sand

Distance to coast: 14 – 20 km

Foundation: Monopiles

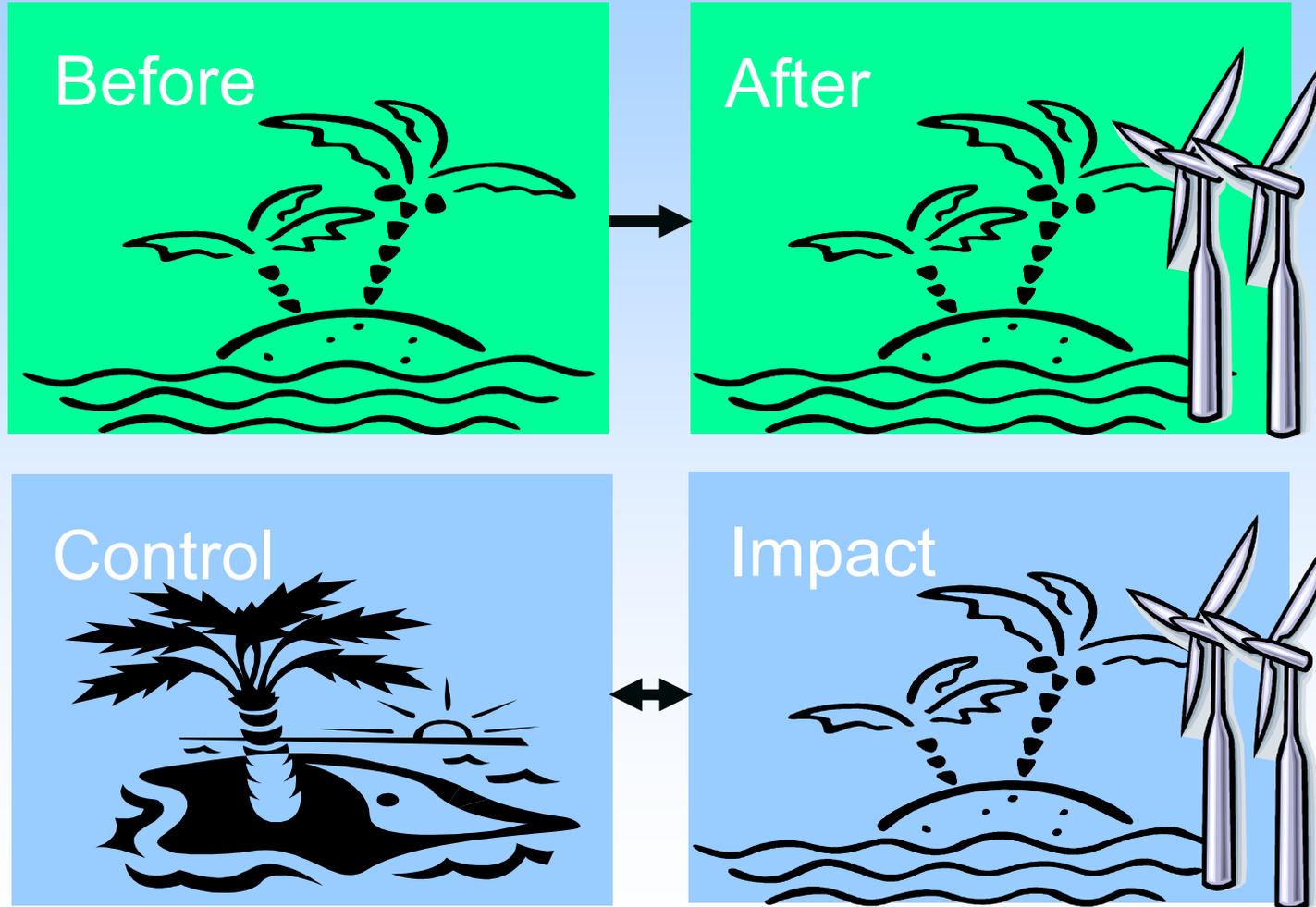


# Administrative set up

- The demonstration program is public funded
- All data and results are available
- The Danish environmental group:
  - The Danish Energy Authority
  - The Danish Forrest and Nature Agency
  - Energi E2
  - Elsam
- An expert panel evaluates the outcome



# The BACI design



# Overview of the Monitoring Program

- Hydrography
- Coastal morphology
- Benthic fauna
- Artificial reef effect
- Fish
- Electromagnetic fields
- Temperature gradients around the cable
- Submarine noise emission
- Birds
- Seals
- Harbour porpoises
- Socio- and environmental economic effects



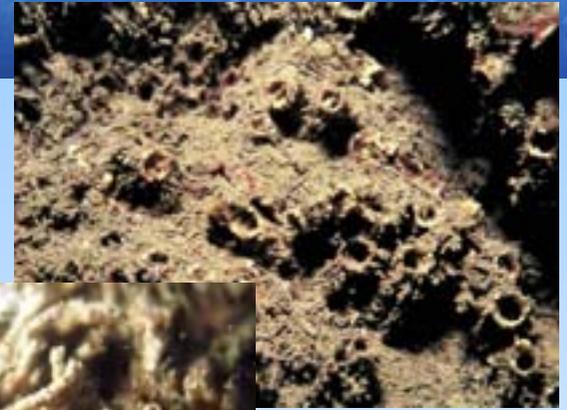
# Artificial reef effect - Methods

- Flora/fauna sampling, photo and video records
- The full foundation is monitored
- A natural stone reef is used as reference



# Artificial reef effect - conclusions

- New species introduced, e.g. *Sabellaria*
- Dramatic increase in biomass
- Comparable to a natural stone reef



# Fish – Sand eel

## ■ Metode

- Sand eel dredge and sediment samples in 2002 and 2004

## ■ Results

- No indications of change in sediment composition due to the construction work
- Sand eels biomass increased by 300% in the wind farm area from 2002 to 2004. The increase was less in the reference area.



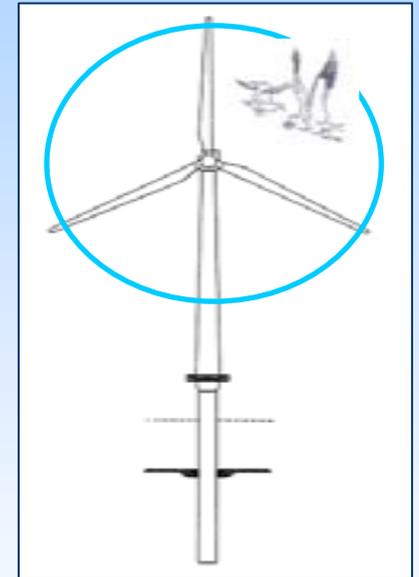
# Birds - potential effects of the wind farm

## ■ Habitat loss

- Do loss or shift in foraging area have an effect?
- Wind farm located near EU-habitat area

## ■ Risk of collision

- Focus on long-lived species such as waterbirds
- Internationally important migration corridor



# Birds – species of special interest

## Horns Rev OWF

Diver



Common Scoter



Gannet



## Nysted OWF

Eider and Geese



Long-tailed duck

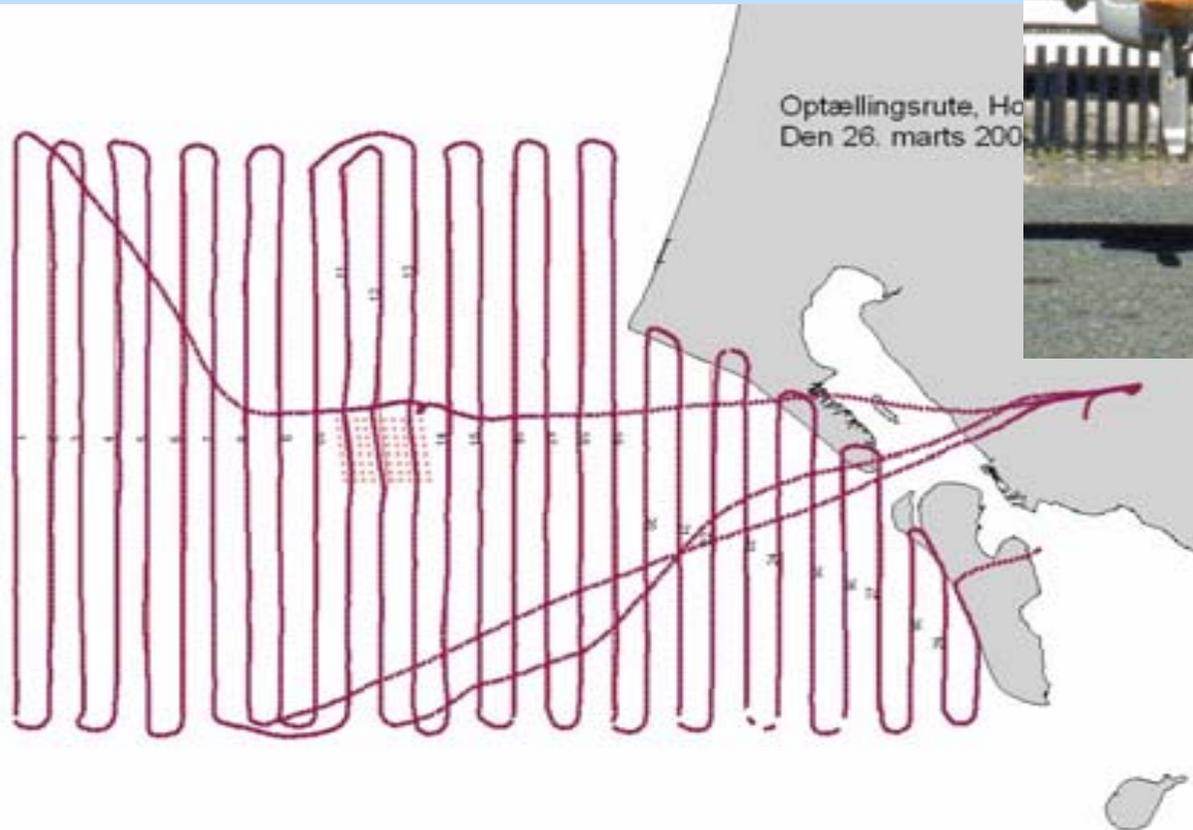


Cormorants



# Birds – habitat loss, methods

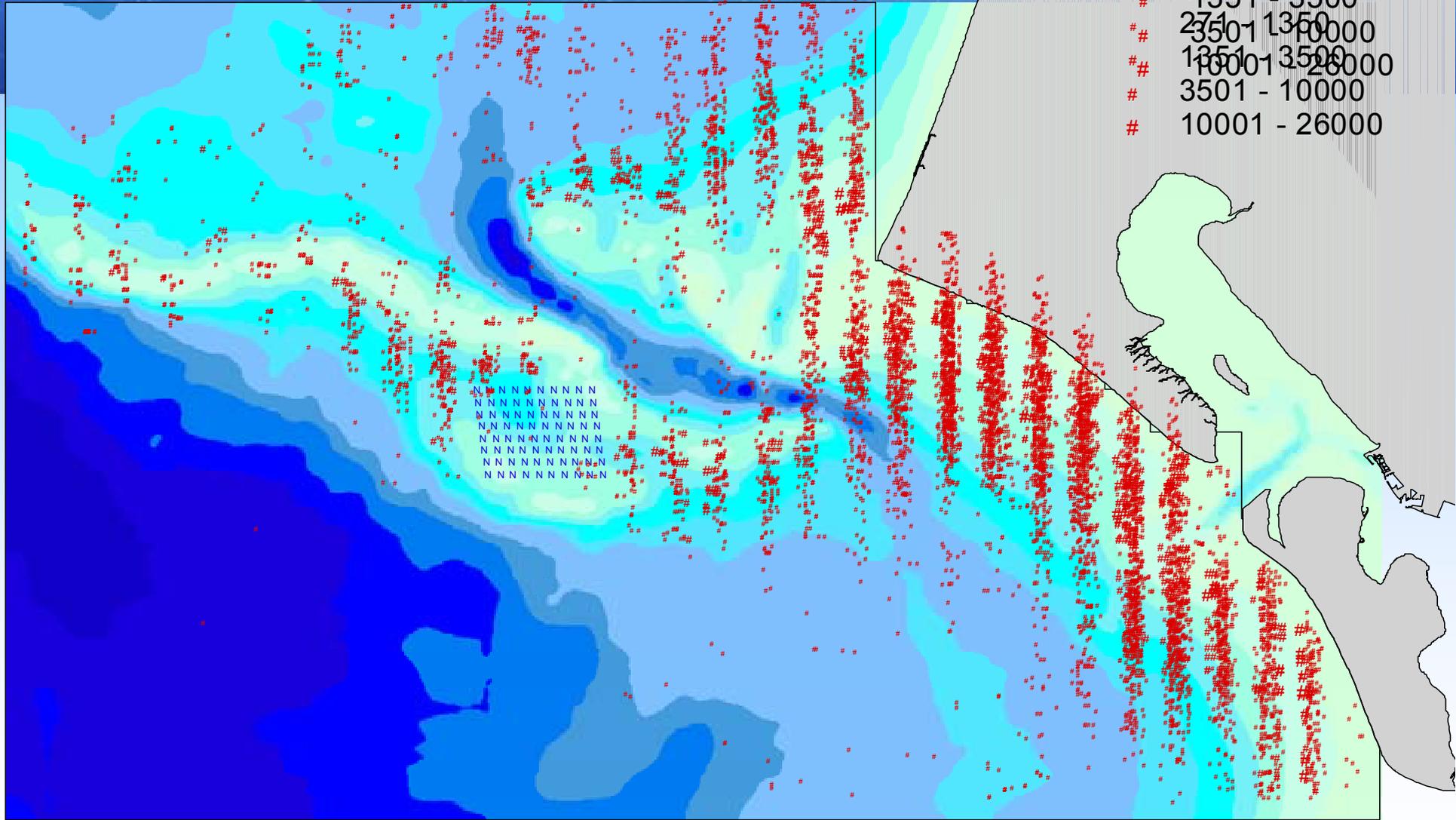
Aerial surveys are carried out  
spring and autumn



Pre-construction

# Common Scoter

Post-construction



0 5 10 Kilometers



# Birds - conclusions on habitat loss

- The area around both wind farms were characterised by low local feeding densities of birds, so major effects on bird distributions were never expected
- **Displacement** of Diving ducks - e.g. Long-tailed Duck and Common Scoter
- **Attraction** Cormorants are resting on the superstructures, and Herring Gull are attracted to the wind farm
- It is too soon after construction to conclude whether displaced species will habituate to the presence of wind turbines

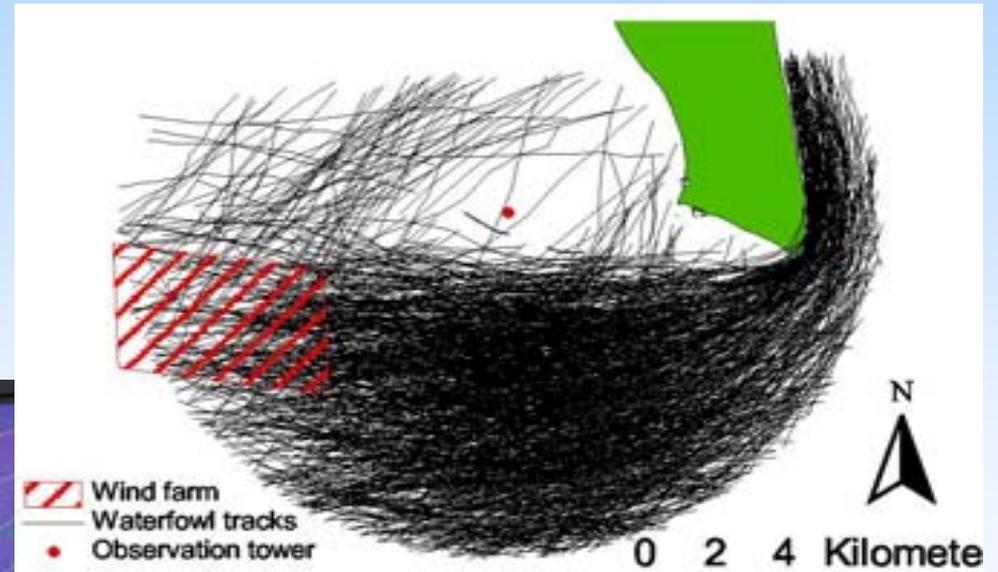
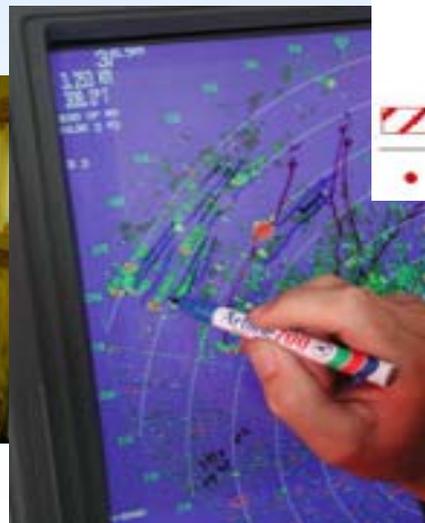
# Birds - collision risk



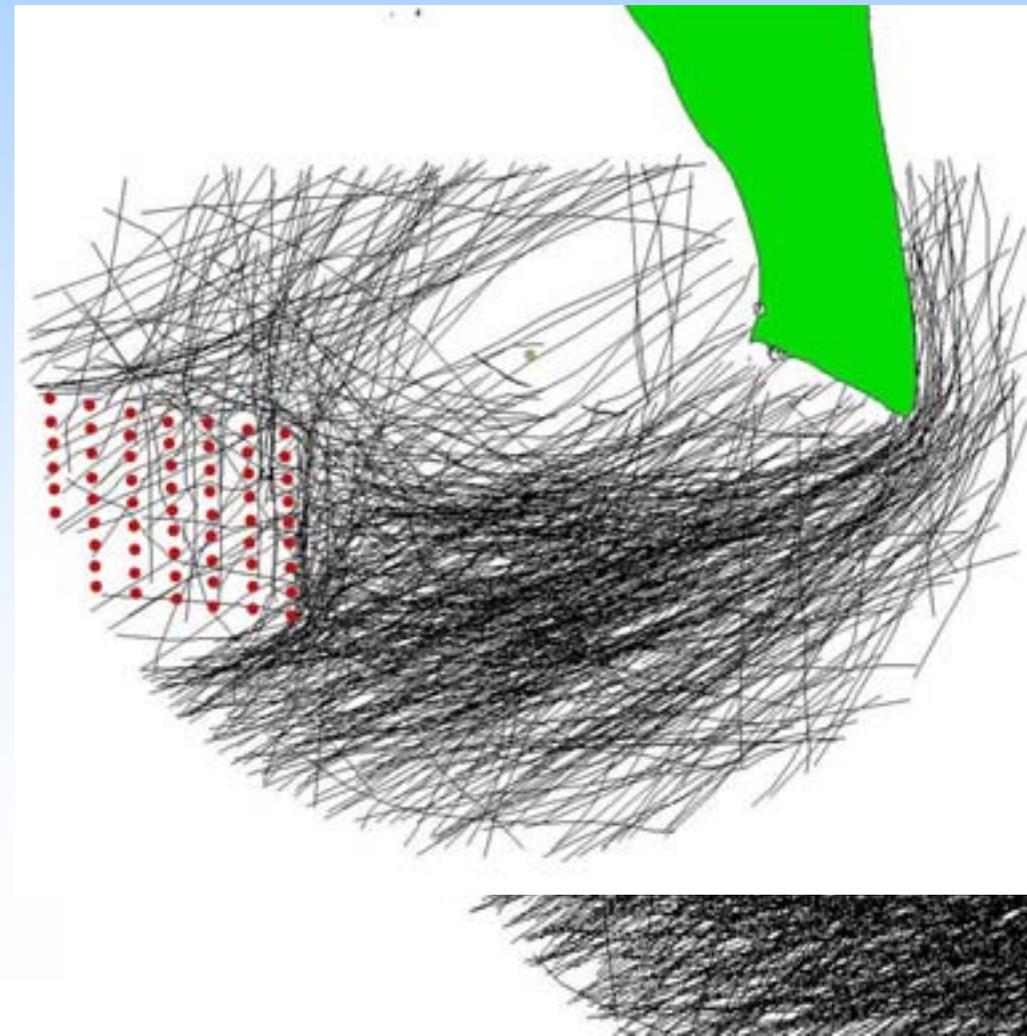
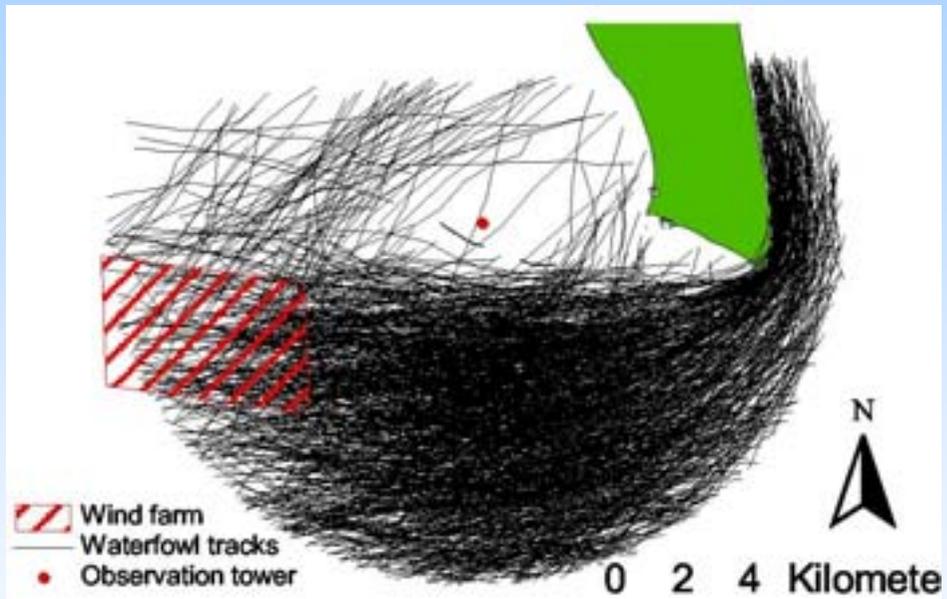
Assessing the collision risk:  
Focus on waterfowl migration, and their  
avoidance response to offshore wind  
turbines



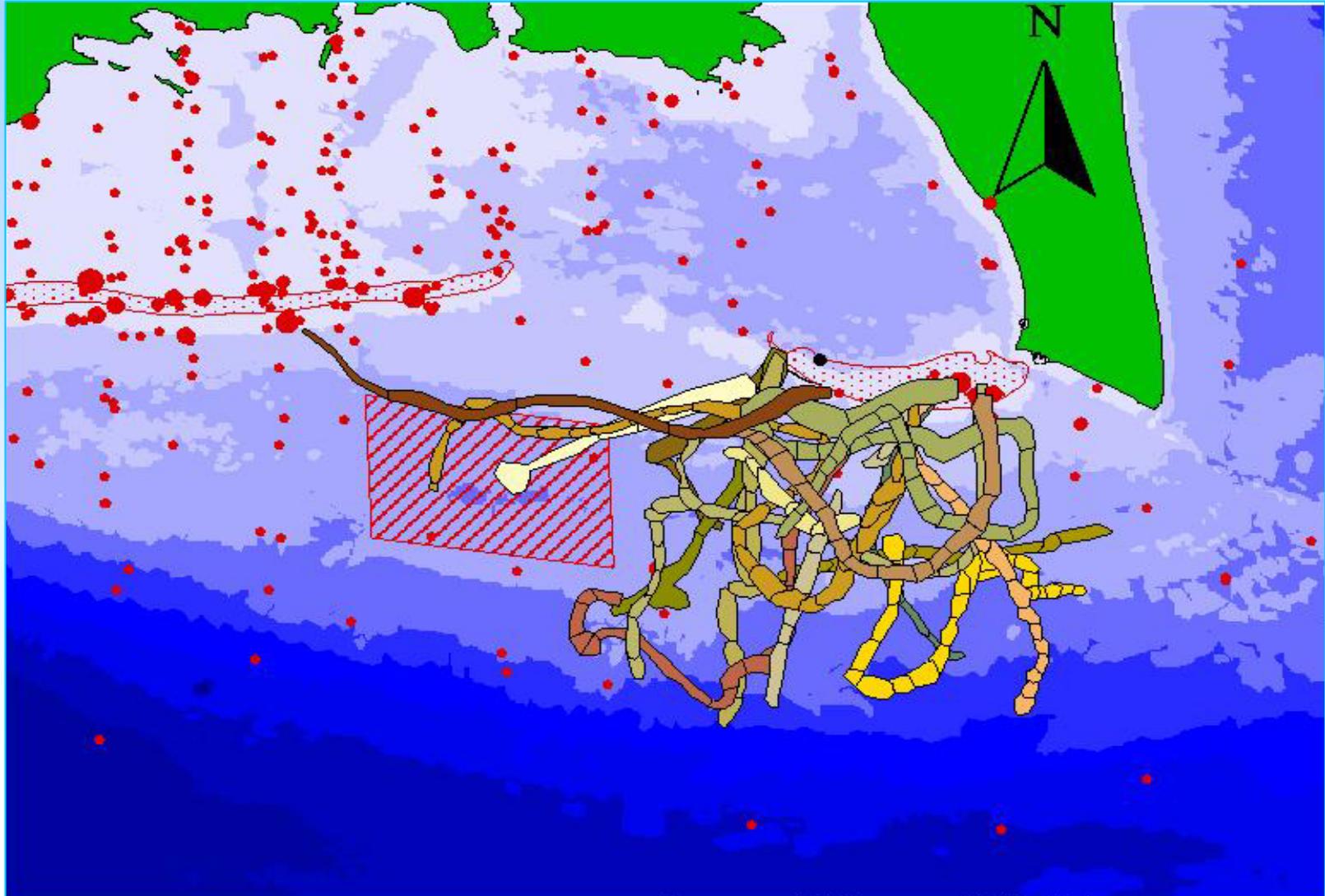
# Birds – radar observations



# Birds – radar observations



# Birds – cormorants, social foraging



# Birds - infrared camera



# Birds – conclusions on collision risk

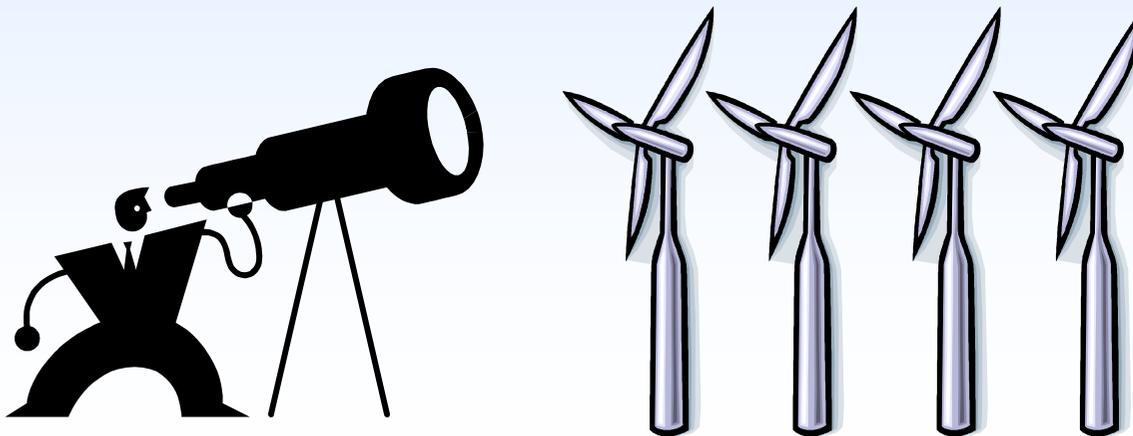
- In general only very few birds fly through or above the wind farms
- Change in waterfowl tracks at a distance of 3,000 m from the wind farm during daytime and 1,000 m during night time.
- During baseline studies approx. 35% of the flocks of waterfowl flew into the wind farm area compared to 9% in the operation phase.
- Less than 1 % of the birds fly close enough to the turbines to be at any risk of collision.

# Did we monitor all?



# General conclusions on monitoring

- Agree on the scope!
- Select the focus for the survey!
- Use all known knowledge – also generalization!
- Get the big picture!
- The future ➡ spatial modelling and planning



# Final Results

The Danish  
Monitoring Programme

27-29 NOVEMBER 2006

| Info

| Preliminary programme

| Registration

| Venue

## Conference

### Offshore Wind Farms and the Environment

Horns Rev and Nysted

## Main themes

Bird habitat loss and collision risk  
Effects on marine mammals  
Introduction of hard bottom substrate  
Fish attraction  
and much more...

[www.hornsrev.dk](http://www.hornsrev.dk)

[www.nystedhavmoellepark.dk](http://www.nystedhavmoellepark.dk)

[www.ens.dk](http://www.ens.dk)

[www.sns.dk](http://www.sns.dk)



**Thank you for listening!**



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**ENERGI E2**