



Bureau Waardenburg  
Ecology & Landscape  
[www.buwa.nl](http://www.buwa.nl)



# Offshore wind farms: Cumulative impact assessment in the Netherlands

A. Potiek, A. Gyimesi, R.C. Fijn, J.J. Leemans





OFFSHORE

## WHAT WE STUDY

### OPPORTUNITIES

- Increased hard substrate
- Better refuge function
- Increased feeding and resting
- Increased biodiversity



OFFSHORE / ONSHORE

### RISKS

- Barrier effects
- Collisions
- Habitat loss
- Avoidance

- Habitat loss
- Avoidance
- Underwater noise
- Electromagnetic fields

ONSHORE

### MITIGATION

- Shut down on demand
- Paint it black
- Deter by sound
- Habitat management
- Location choice
- Lay-out & design

## HOW WE DO THAT

- Ecofriendly scour protection
- Ecological enhancement
- Biogene reef restoration

- Bird distribution using aerial surveys
- Flight patterns & -behavior using bird radars
- Flight patterns & -behavior using GPS-tagged birds
- Collision risk & population modelling
- Cumulative effects / EIAs

- Radar triggered shutdown
- Monitoring collisions and flight behavior
- Monitoring bat activity
- Habitat management plan





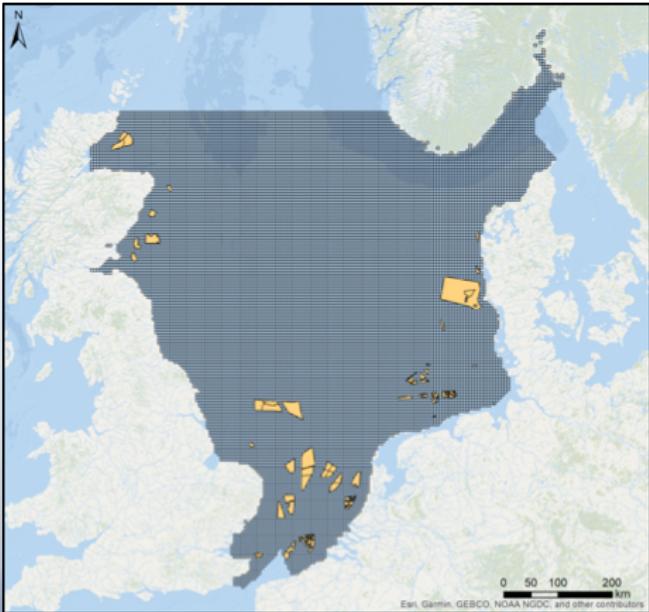
# Dutch Governmental Offshore Wind Ecological Program: “WOZEP”





# Wozep objectives

- Knowledge gaps in cumulative impact assessment
- Southern and central North Sea



Scenario: all wind farms  
planned until 2030



# Wozep objectives

- Knowledge gaps in cumulative impact assessment
- Southern and central North Sea
- Birds, bats, marine mammals;
- Also physical ecosystem-effects (e.g. stratification)
- Resulting knowledge is used within environmental impact assessments





# Overview Wozep projects

- Surveys
- Radar
- Tracking studies

## Cumulative impact assessment

- Effect on demographic rates: collision rate modelling, habitat loss
- Population-level impact





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- Surveys
- Radar See: [www.buwa.nl/en/3d-birdradar-max](http://www.buwa.nl/en/3d-birdradar-max)
- Tracking studies

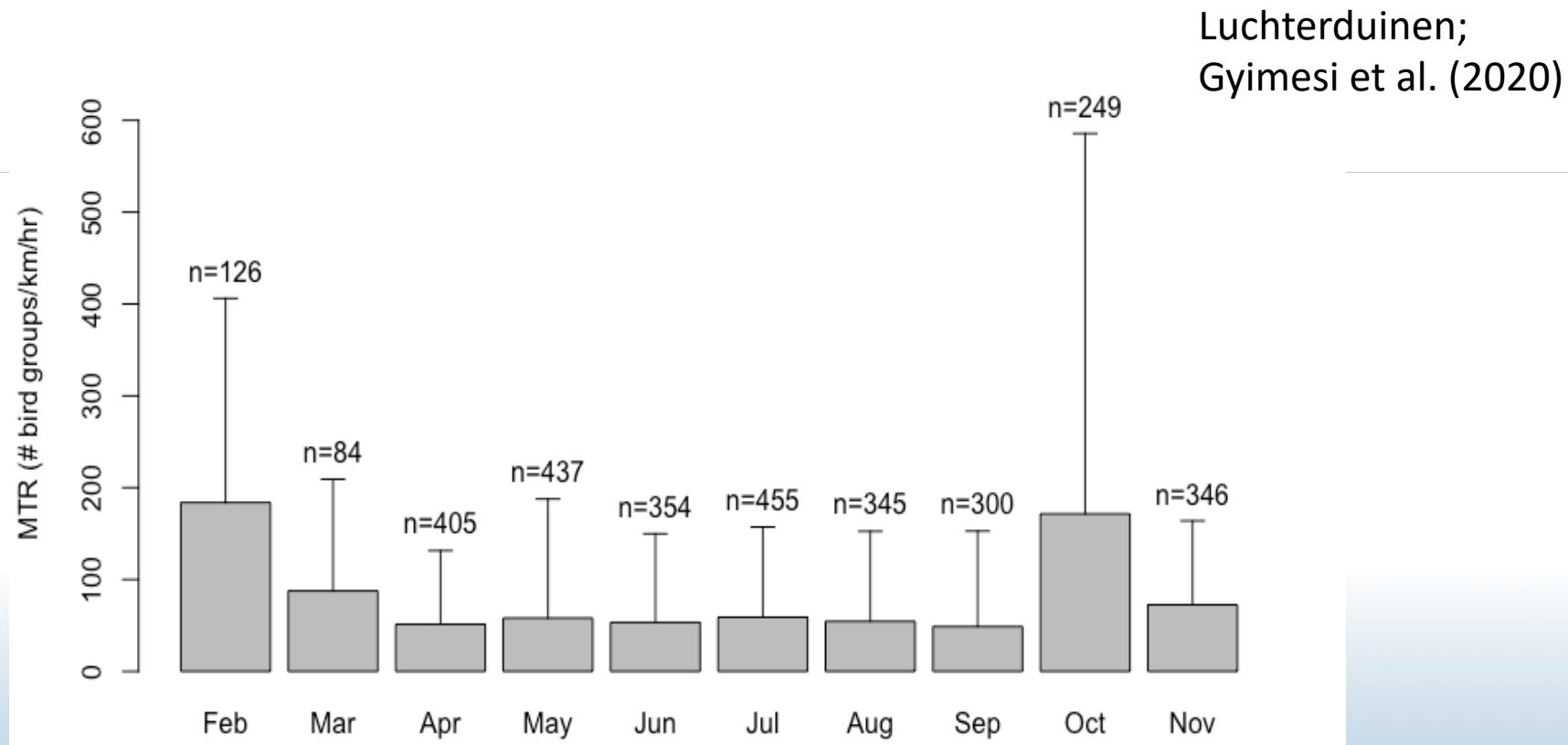
## Cumulative impact assessment

- Effect on demographic rates: collision rate modelling, habitat loss
- Population-level impact





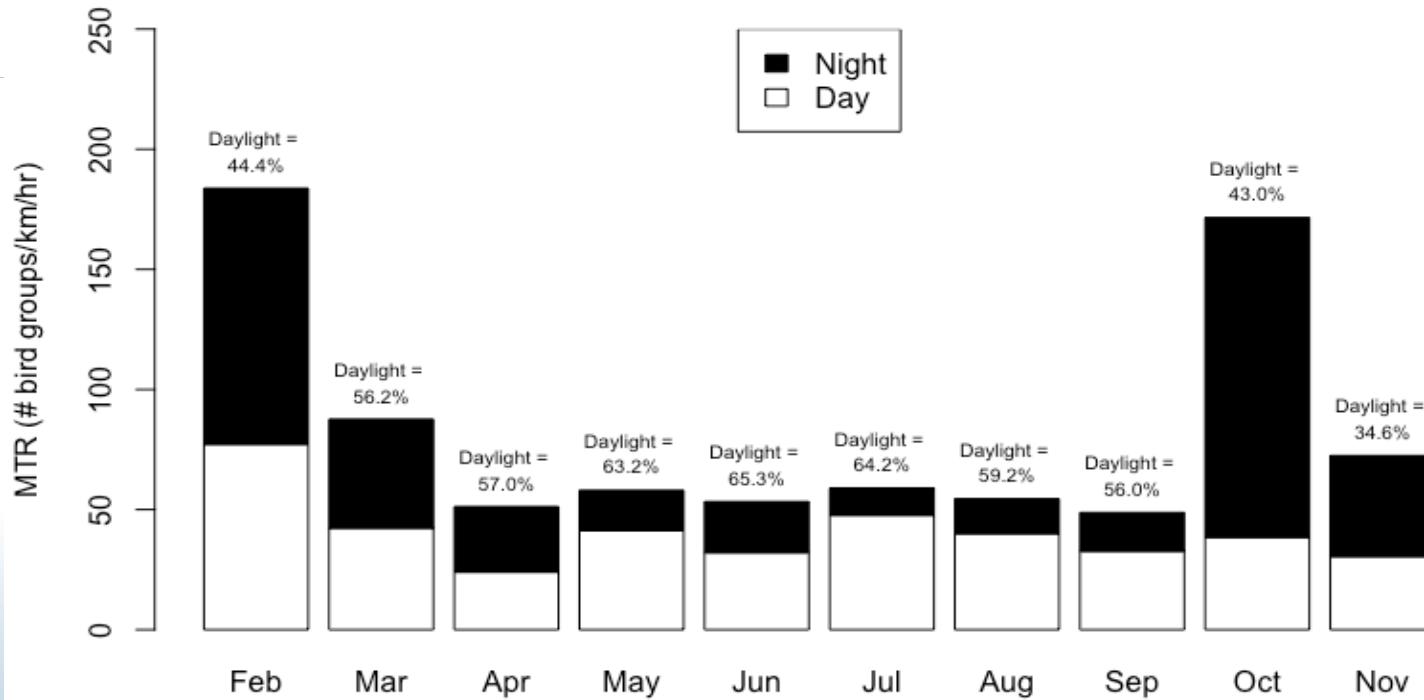
# Radar measurements: Mean Traffic Rates





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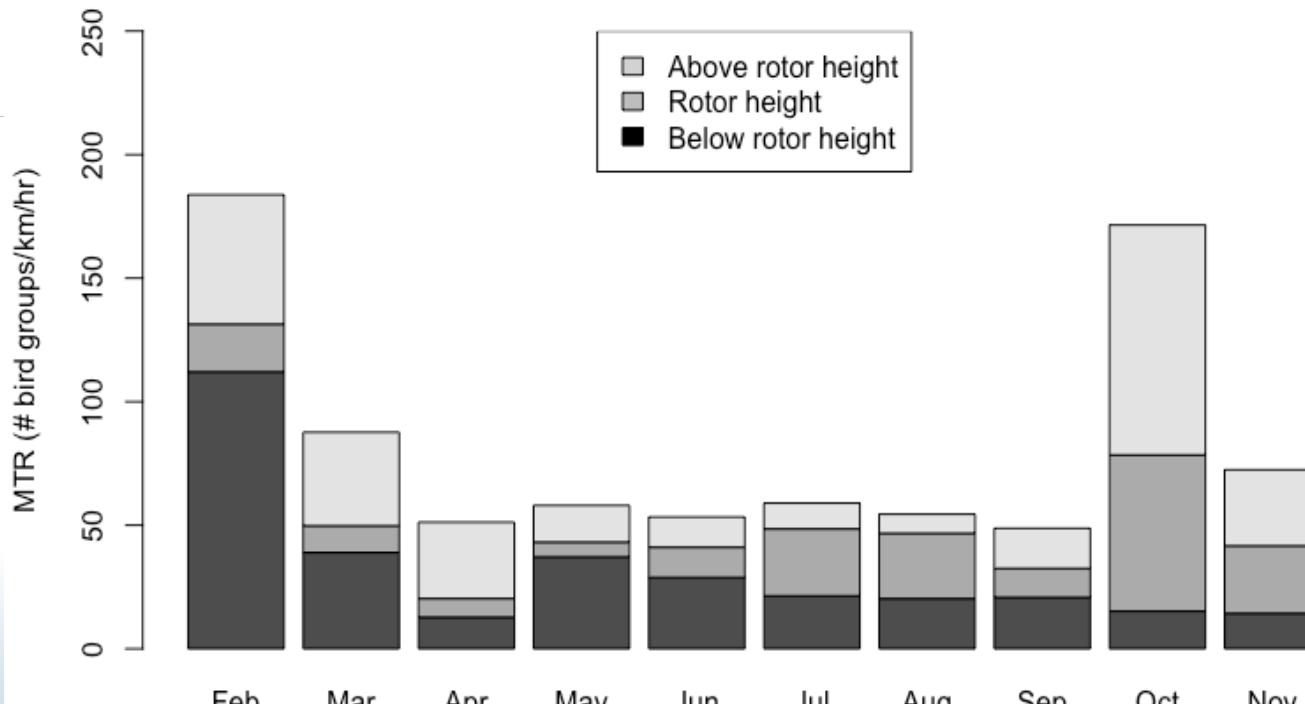
Luchterduinen;  
Gyimesi et al. (2020)





# Radar measurements: Mean Traffic Rates

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# Overview Wozep projects

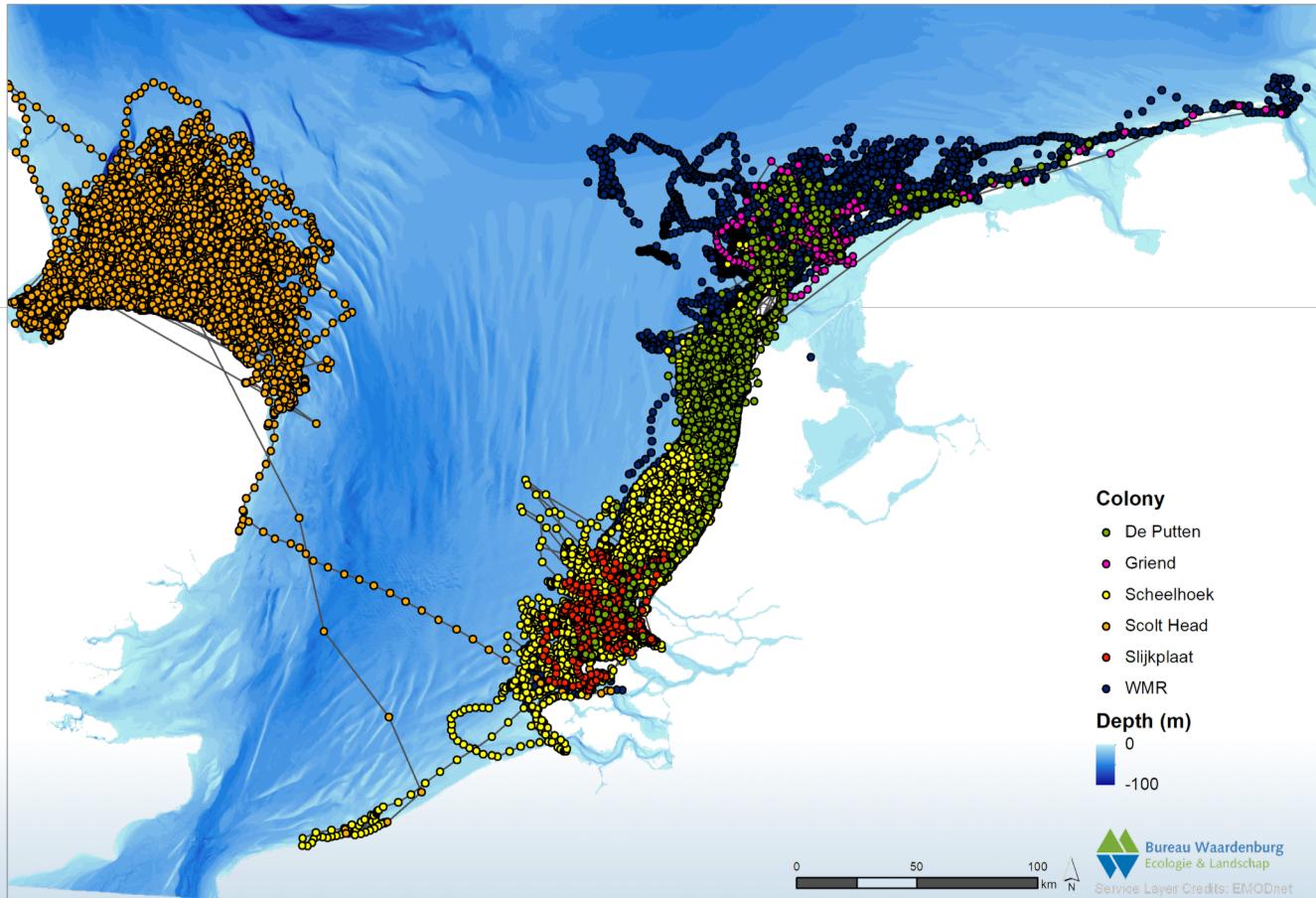
- Surveys
- Radar
- **Tracking studies**

## Cumulative impact assessment

- Effect on demographic rates: collision rate modelling, habitat loss
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- Surveys
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## Cumulative impact assessment

- Effect on demographic rates: collision rate modelling, habitat loss
- Population-level impact



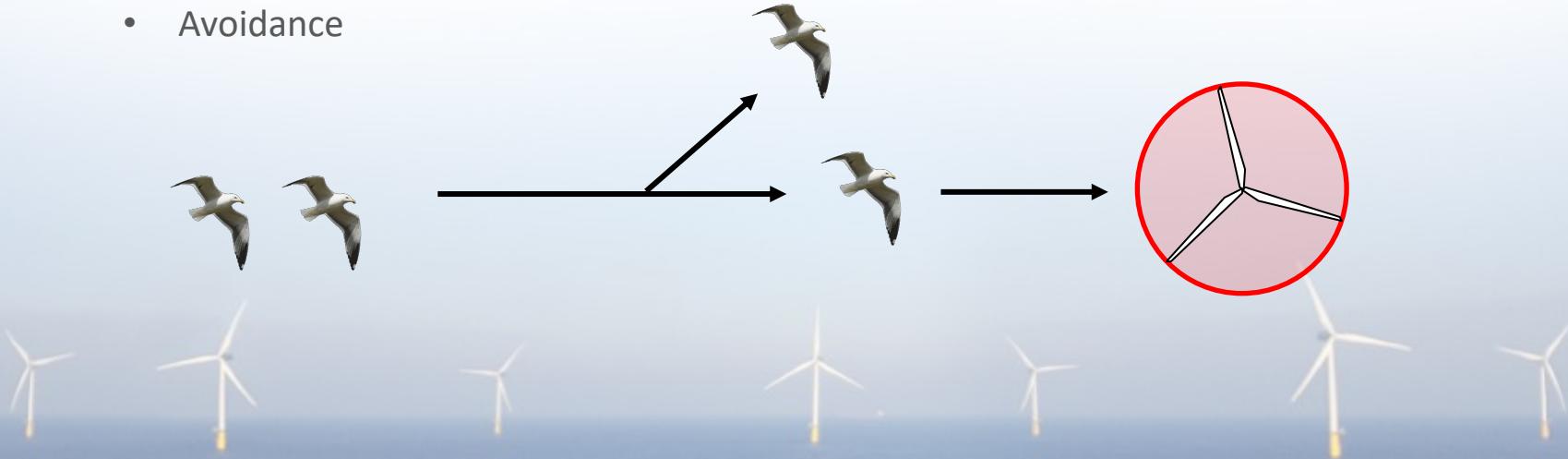


# Cumulative impact assessment

Impact of turbine collisions on birds

SOSS Band model -> number of victims

- Number of local crossings (bird density)
- Probability of collision when crossing rotor-swept area (collision risk)
- Avoidance





# Cumulative impact assessment

First report in 2015

Updated in 2019

**A first approach to deal with  
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and bats of offshore wind farms  
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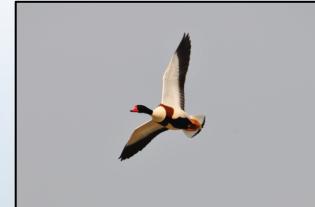
Report number C166/14





# Species sensitive to turbine collisions

- Lesser black-backed gull
- Great black-backed gull
- Herring gull
- Kittiwake
- Little gull
- Great skua
- Arctic skua
- Brent goose
- Shelduck
- Curlew
- Black tern
- Common tern
- Bewick's swan





# Population-level impact

From number of victims to population-level impact

(Potiek *et al.* 2019)

## Population models

- Projection population trend for current situation, and scenario with additional mortality
- Explicit assumptions
- Input: demographic rates
  - age-specific survival (with and without additional mortality)
  - fecundity,
  - probability of breeding,
  - initial population size

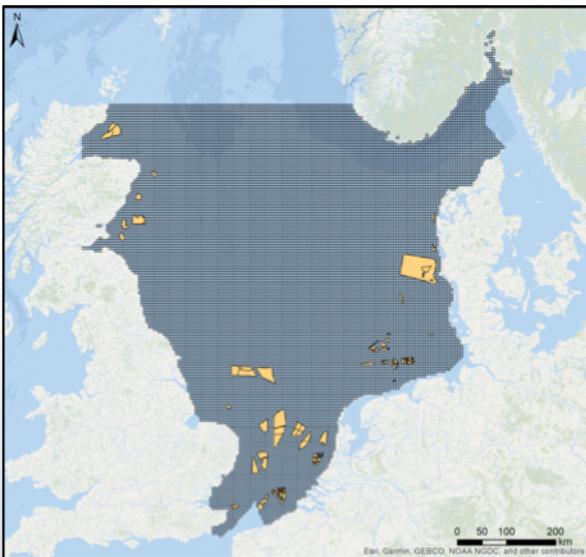




# Population-level impact

Population definition

(Potiek *et al.* 2019)



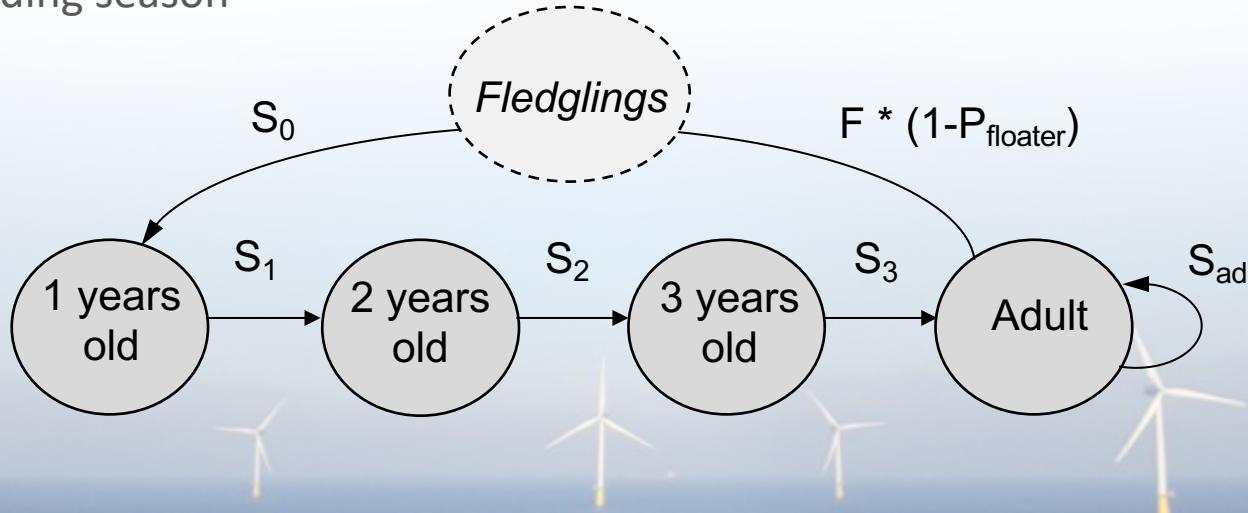


# Population-level impact

Matrix models:

(Potiek *et al.* 2019)

- Leslie matrices (Caswell 2001)
- Time step is 1 year
- Projection of number of individuals per age class at the start of the breeding season





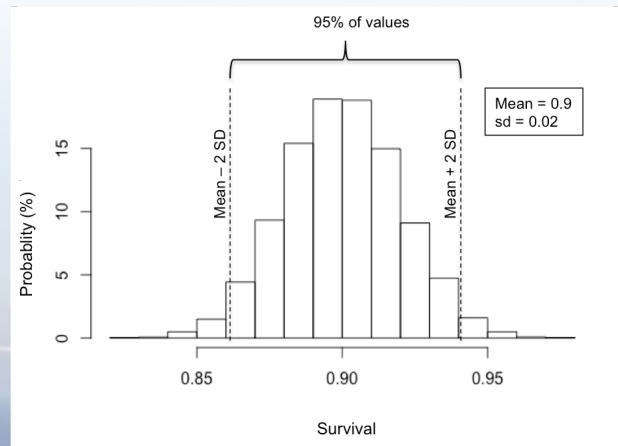
# Population-level impact

Assumptions:

(Potiek *et al.* 2019)

- Stochasticity, different outcome for each simulation
- No density-dependence
- Age structure among victims:

Lesser black-backed gull: offshore 80% adults (Camphuysen & Leopold 1994)





## Spatial and temporal distribution of different age classes of seabirds in the North Sea

Analysis of ESAS database



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Northern gannet

Arctic skua

Great skua

Little gull

Great black-backed gull

Black-legged kittiwake

Black tern

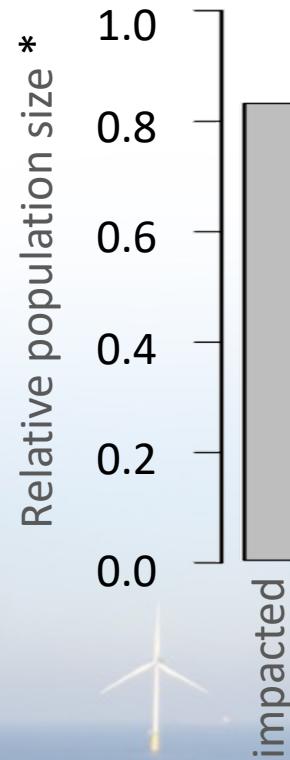
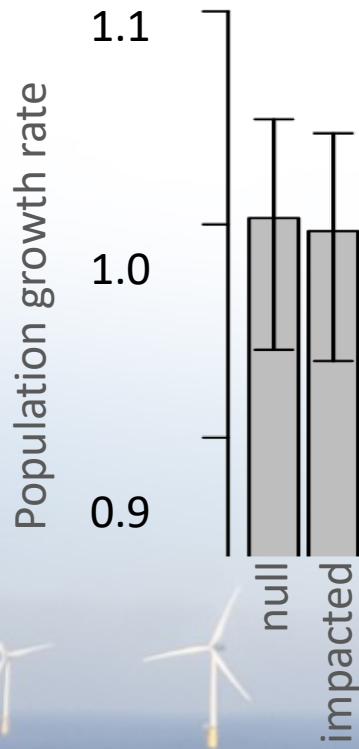
Common tern



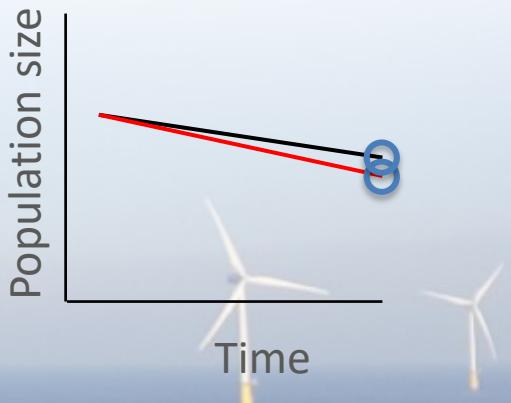


# Population-level impact

Lesser black-backed gull



\* median  $N_{30\_impact} / N_{30\_null} = 0.83$





# Population-level impact: results

Relative population size after 30 years

	Median N30_impact / N30_null
Lesser black-backed gull	0.83
Great black-backed gull	0.93
Herring gull	0.95
Kittiwake	0.98
Great skua	1
Arctic skua	0.99
Common tern	0.97
Black tern	0.79
Bewick's swan	0.98
Brent goose	0.98
Common shelduck	0.82
Curlew	0.76





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# Population-level impact: results

## Probability of 10% decline

	Probability of 10% decline within 30 years	
	Null scenario	Impacted scenario
Lesser black-backed gull	42	49
Great black-backed gull	57	58
Herring gull	62	63
Kittiwake	56	57
Great skua	36	36
Arctic skua	64	65
Common tern	65	65
Black tern	39	47
Bewick's swan	96	96
Brent goose	43	44
Common shelduck	26	30
Curlew	97	98





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Great skua	36	36
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Brent goose	43	44
Common shelduck	26	30
<b>Curlew</b>	<b>97</b>	98





# Population-level impact: results

Probability of 10% decline

	Probability of 10% decline within 30 years		Absolute change (percentage point)
	Null scenario	Impacted scenario	
<b>Lesser black-backed gull</b>	<b>42</b>	<b>49</b>	+ 7 pp
Great black-backed gull	57	58	+ 1 pp
Herring gull	62	63	+ 1 pp
Kittiwake	56	57	+ 1 pp
Great skua	36	36	+ 0 pp
Arctic skua	64	65	+ 1 pp
Common tern	65	65	+ 0 pp
<b>Black tern</b>	<b>39</b>	<b>47</b>	+ 8 pp
Bewick's swan	96	96	+ 0 pp
Brent goose	43	44	+ 1 pp
<b>Common shelduck</b>	<b>26</b>	<b>30</b>	+ 4 pp
Curlew	97	98	+ 1 pp



# Population-level impact: Conclusions

- For most species, population size after 30 years 1-5% lower as a result of planned wind farms
- Some species with larger impact:

Species	Relative population size	Absolute change in probability of 10% decline
Lesser black-backed gull	0.83	7 pp
Black tern	0.79	8 pp
Shelduck	0.82	4 pp
Curlew	0.76	1 pp



# Population-level impact: Discussion

- Acceptable impact?

ALIs: Acceptable Levels of Impact

- Use of population models in EIAs
- Follow-up: Individual-based models





# Follow-up: Update approach

First report in 2015

Updated in 2019

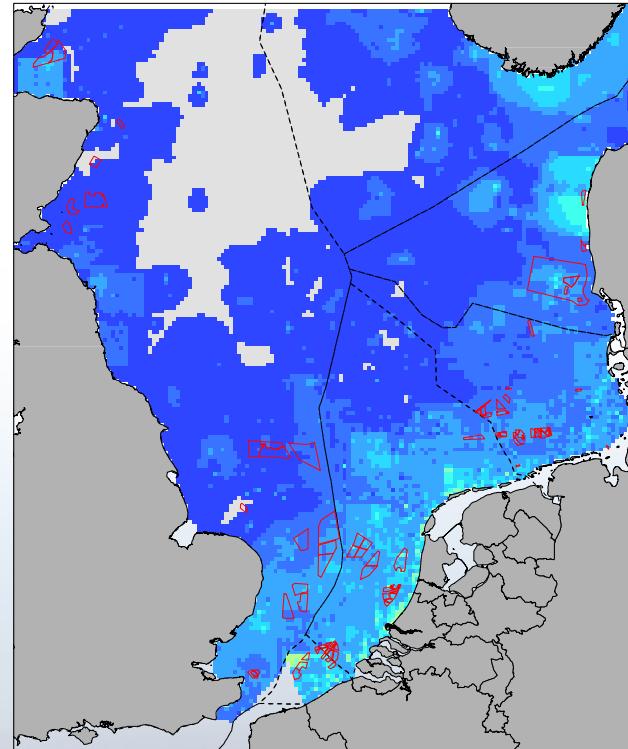
Next update in 2021

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Report number C166/14



Density lesser black-backed gull

0.0	0.8 - 1.0	10.1 - 15.0
0.1	1.1 - 2.0	15.1 - 20.0
0.2 - 0.3	2.1 - 5.0	20.1 - 30.0
0.3 - 0.5	5.1 - 7.5	30.1 - 40.0
0.6 - 0.8	7.6 - 10.0	40.1 - 50.0

wind farms

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# Thank you for your attention!



**Contact:**  
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We kindly invite you to join the Conference on Wind Energy & Wildlife Impacts (CWW) in the Netherlands on the 4 - 8th of April 2022, please contact [info@cww2022.org](mailto:info@cww2022.org) for more information.



[www.cww2022.org](http://www.cww2022.org)