Life-cycle impact assessment of offshore wind energy development on migrating bird diversity in the North Sea

Emma Critchley, Anna Nilsson, Roel May

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Background

- Expected rapid increase in offshore wind developments in the North Sea
- Millions of birds migrate across the North Sea twice a year
- Advances in technology
  - Floating wind farms located much further offshore
  - Larger turbines
- Larger footprint - potential barriers to migration

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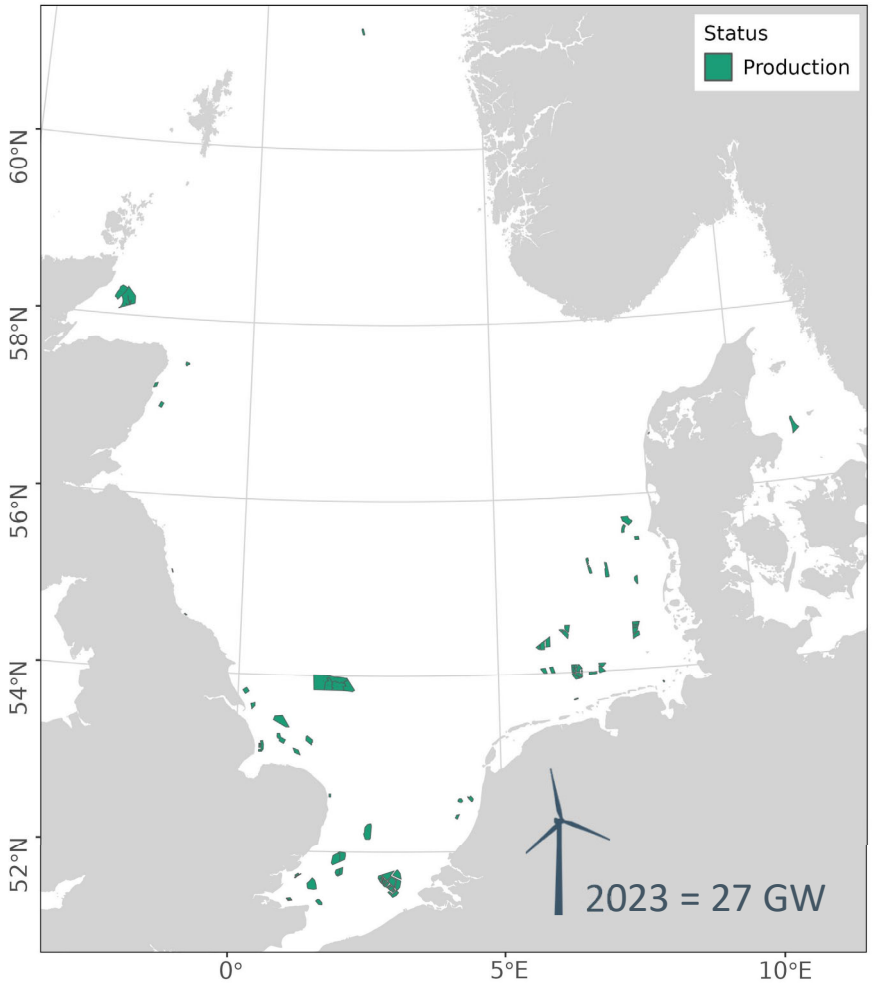
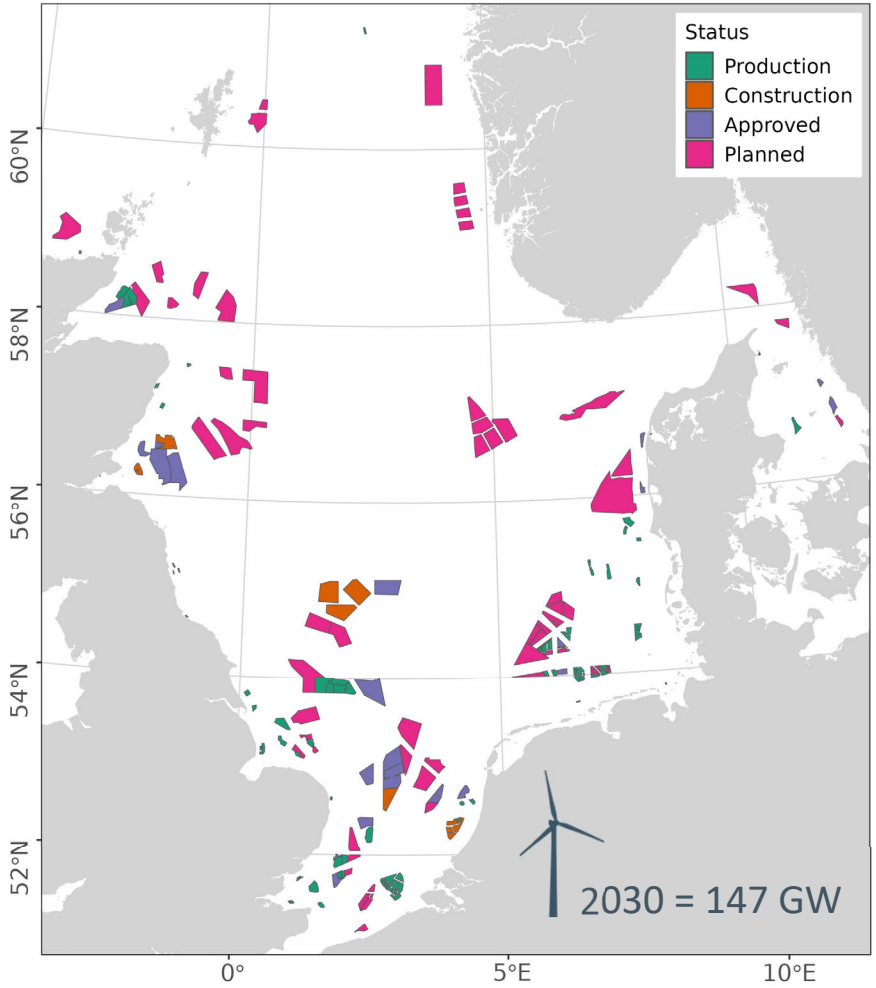
Offshore wind in the North Sea





Methodology

- **Life-cycle impact assessment**
  - Potential impact per unit of stressor
- Stressor: Wind farm energy production (KWh/**GWh**)
- Impacts: Potentially disappeared fraction of species (**PDF**)
  - Loss of species richness of migrating birds in an area
- Impact pathways: **Collison, Disturbance and Barrier**

May, R., Jackson, C.R., Middel, H., Stokke, B.G. and Verones, F., 2021. Life-cycle impacts of wind energy development on bird diversity in Norway. Environmental Impact Assessment Review

May, R., Middel, H., Stokke, B.G., Jackson, C. and Verones, F., 2020. Global life-cycle impacts of onshore wind-power plants on bird richness. Environmental and Sustainability Indicators

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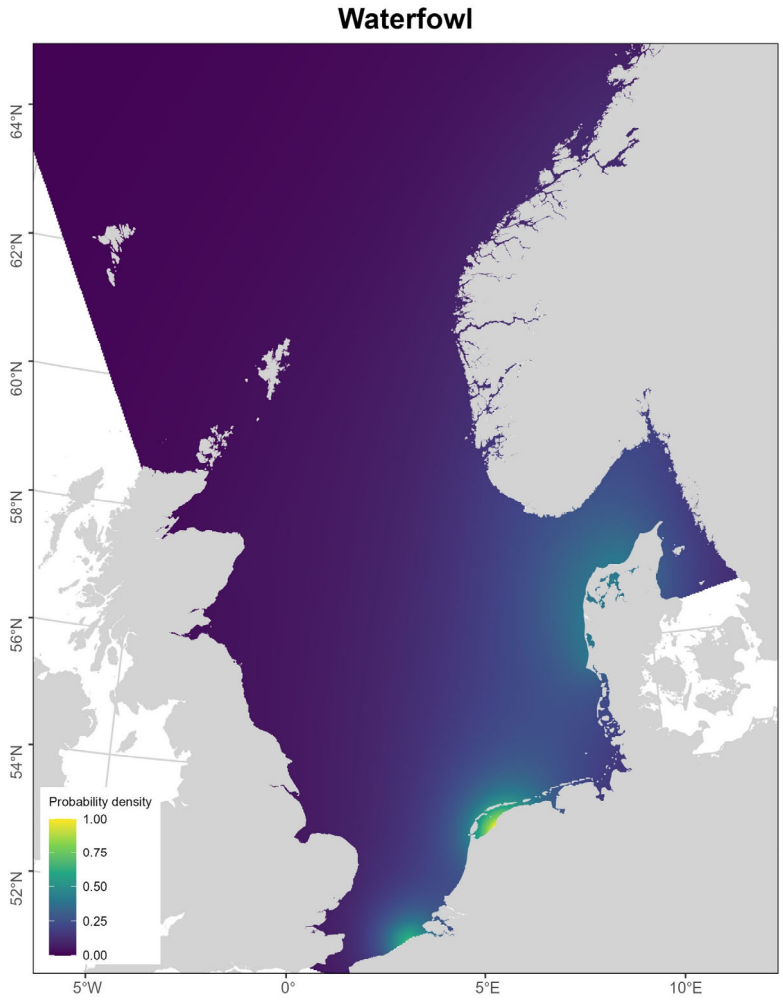
Methodology

- Migrating bird distributions – functional groups

- Calculated PDF values for
  - A) all existing and future North Sea wind farms up to 2030
  - B) 15 MW turbine in every grid square

- Proxy turbine locations & sizes for future wind farms
  - 15 MW

Migrating bird distributions



Brownian bridge models of utilisation distributions from ring recoveries

- Corvids
- Gulls & terns
- Herbivorous songbirds
- Insectivorous songbirds
- Non-passerines
- Owls
- Polyphagous songbirds
- Raptors
- Seabirds
- Waders
- Waterbirds
- Waterfowl

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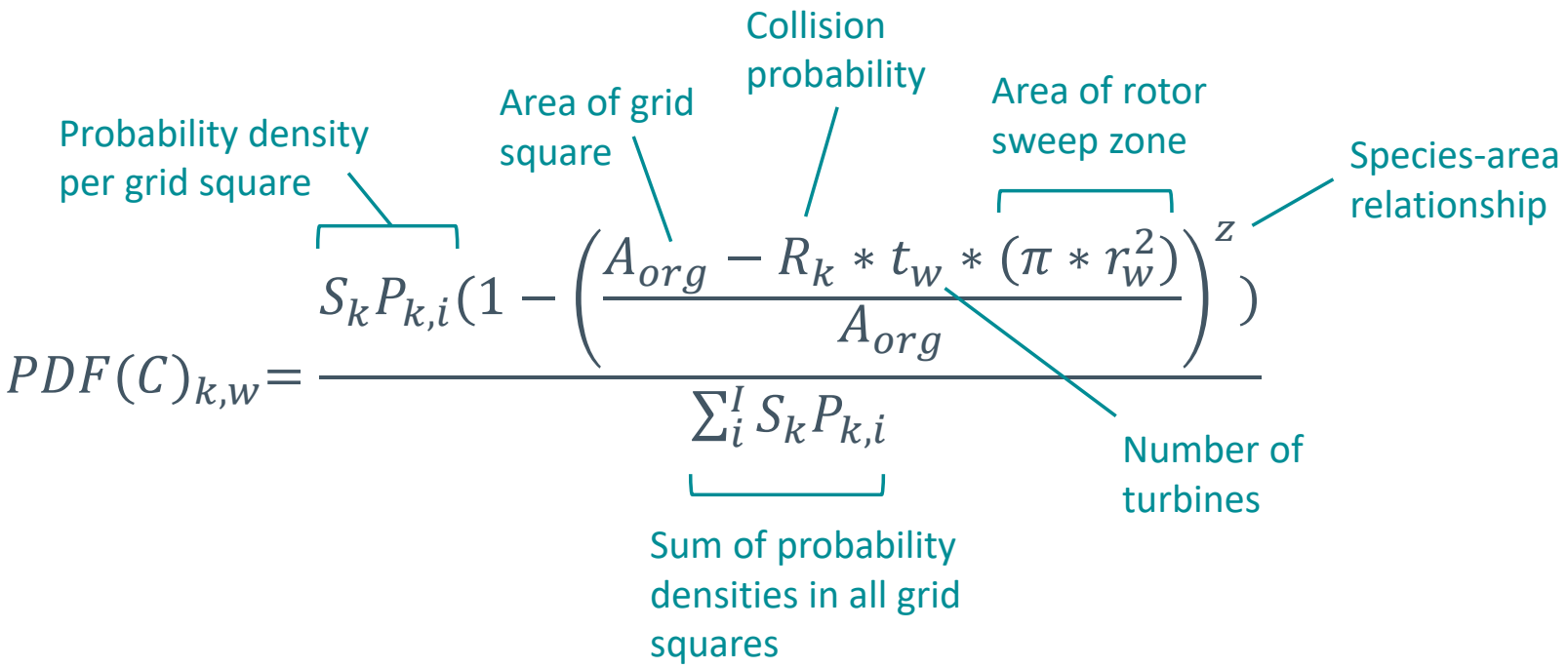
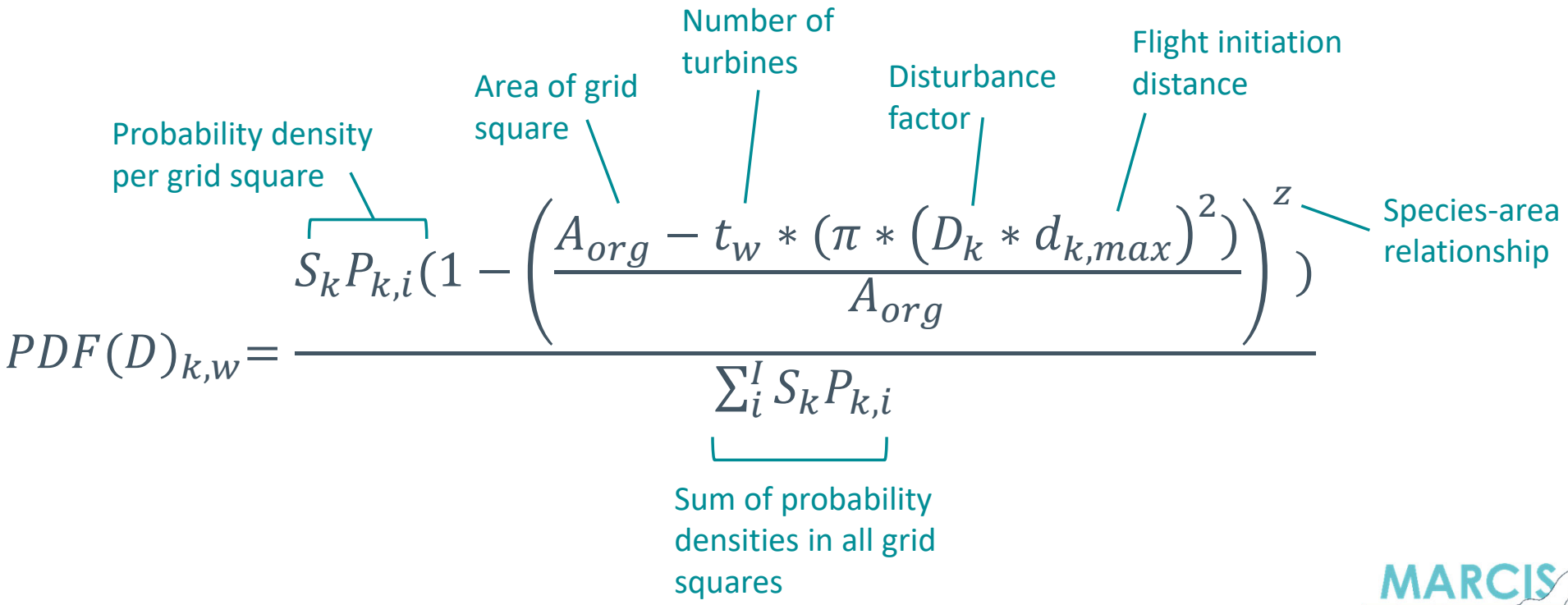
Collision PDF

Reduction of the species at risk due to collision



Disturbance PDF

Proportion of species displaced from the influence area



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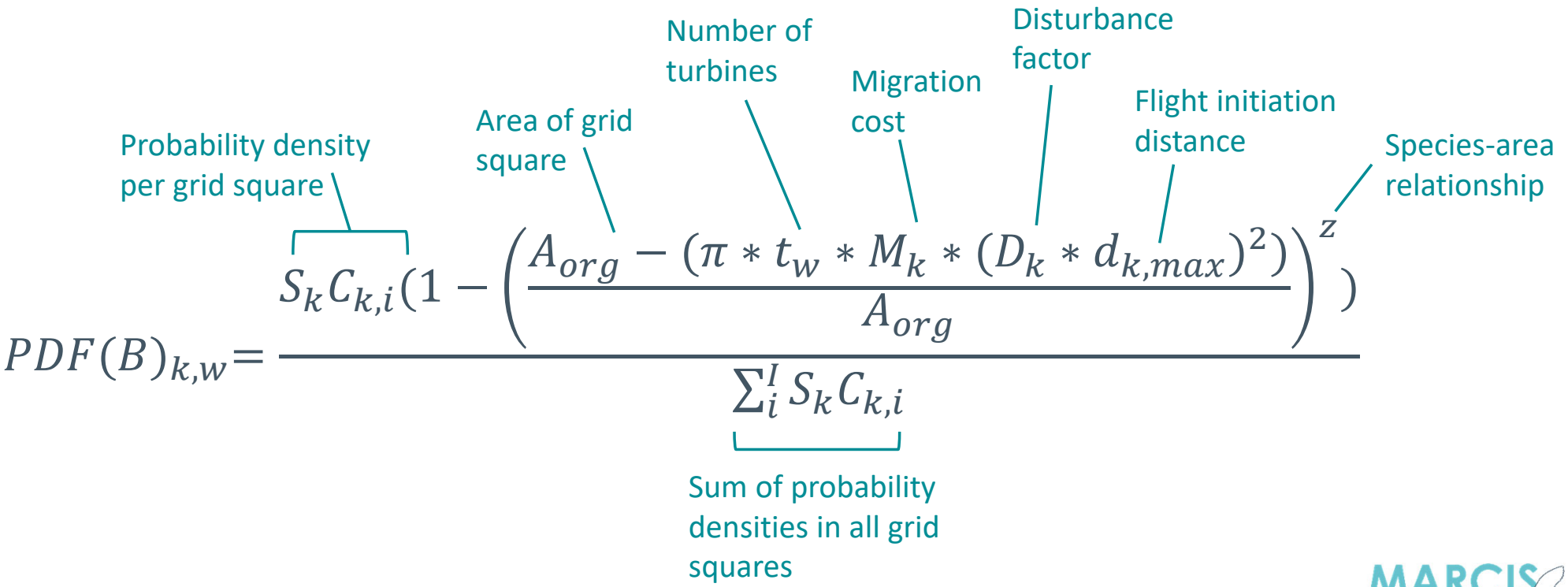
Barrier PDF

Proportion of species displaced with a fitness cost



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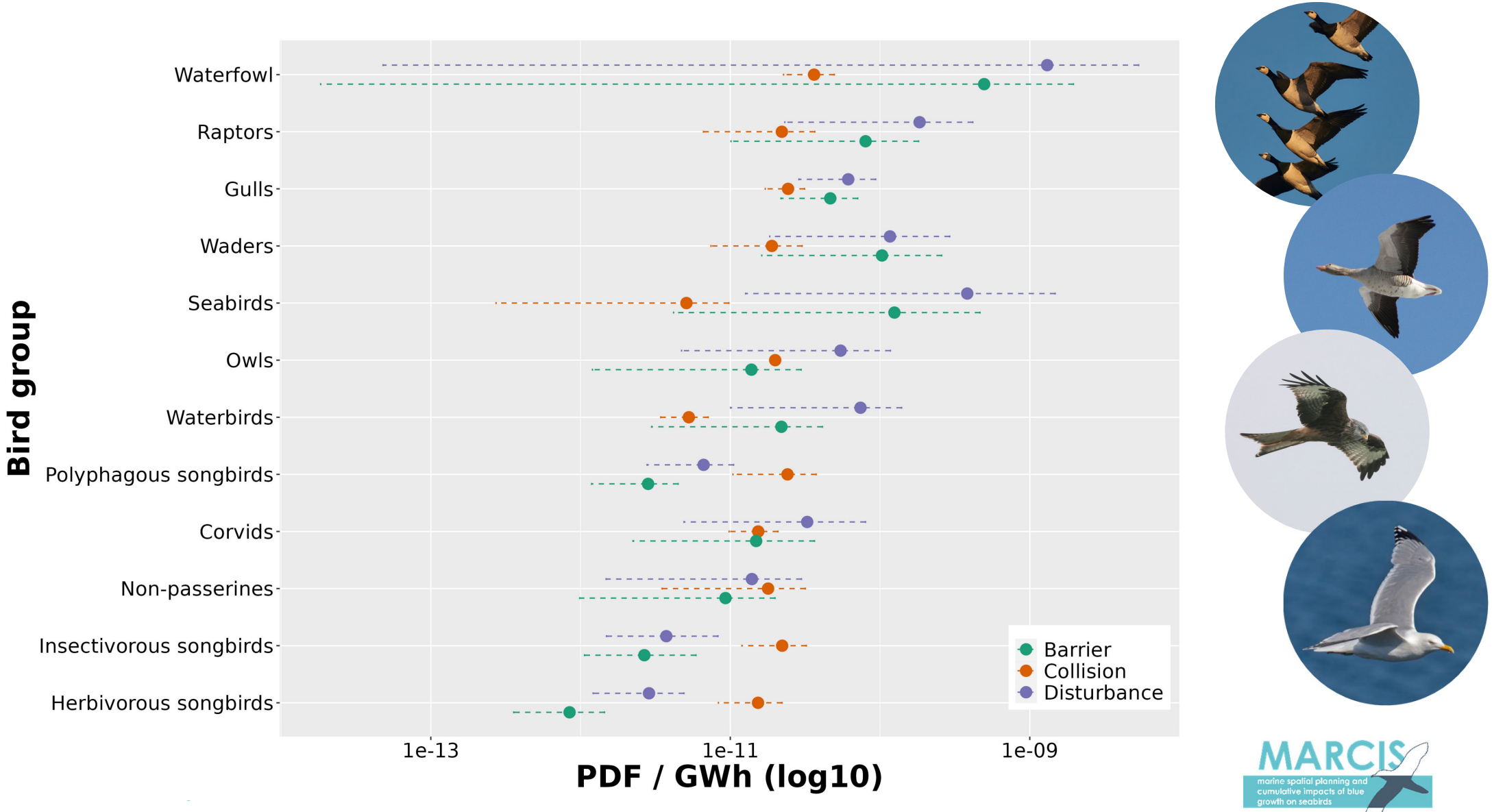
Results



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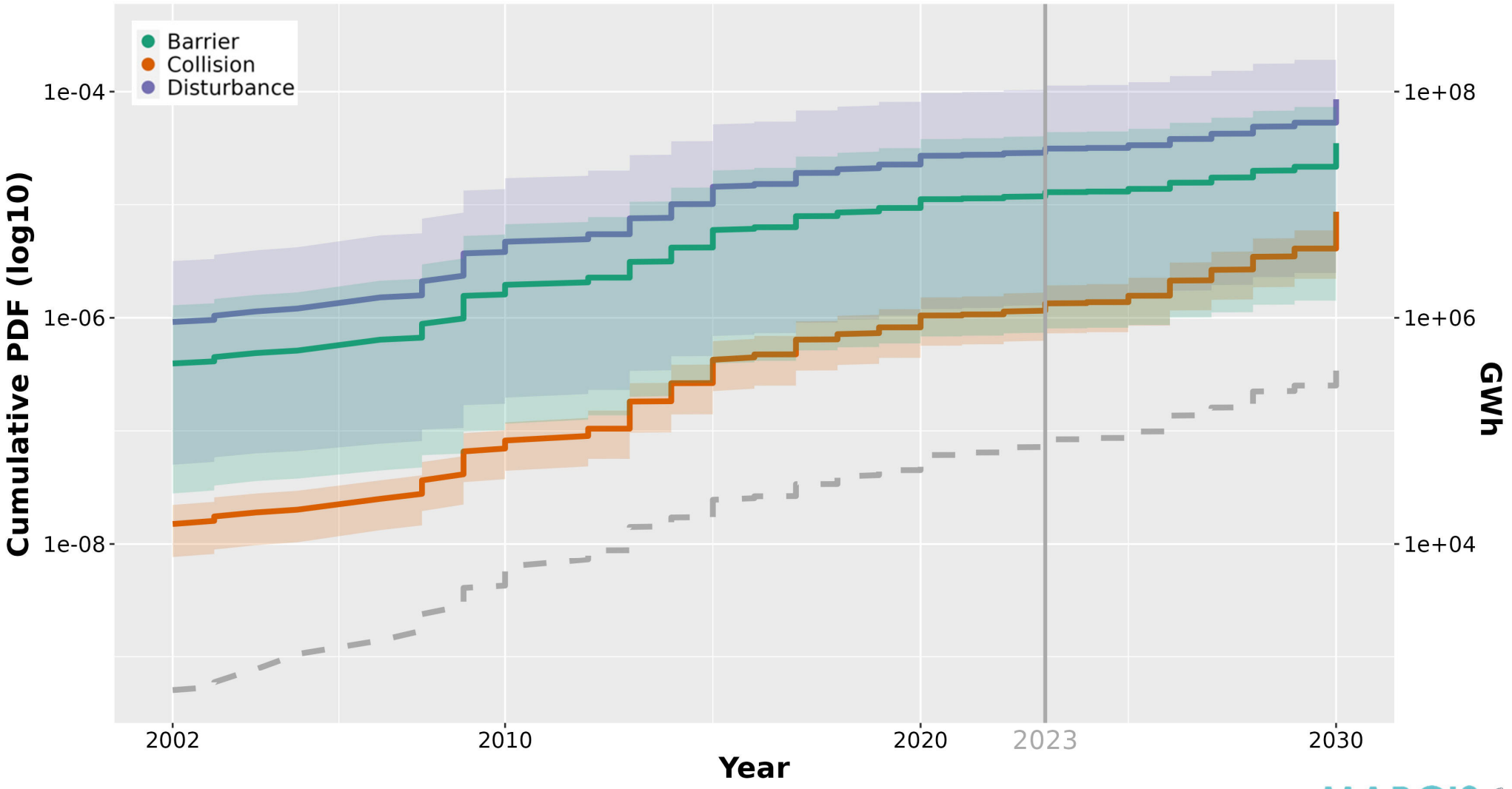

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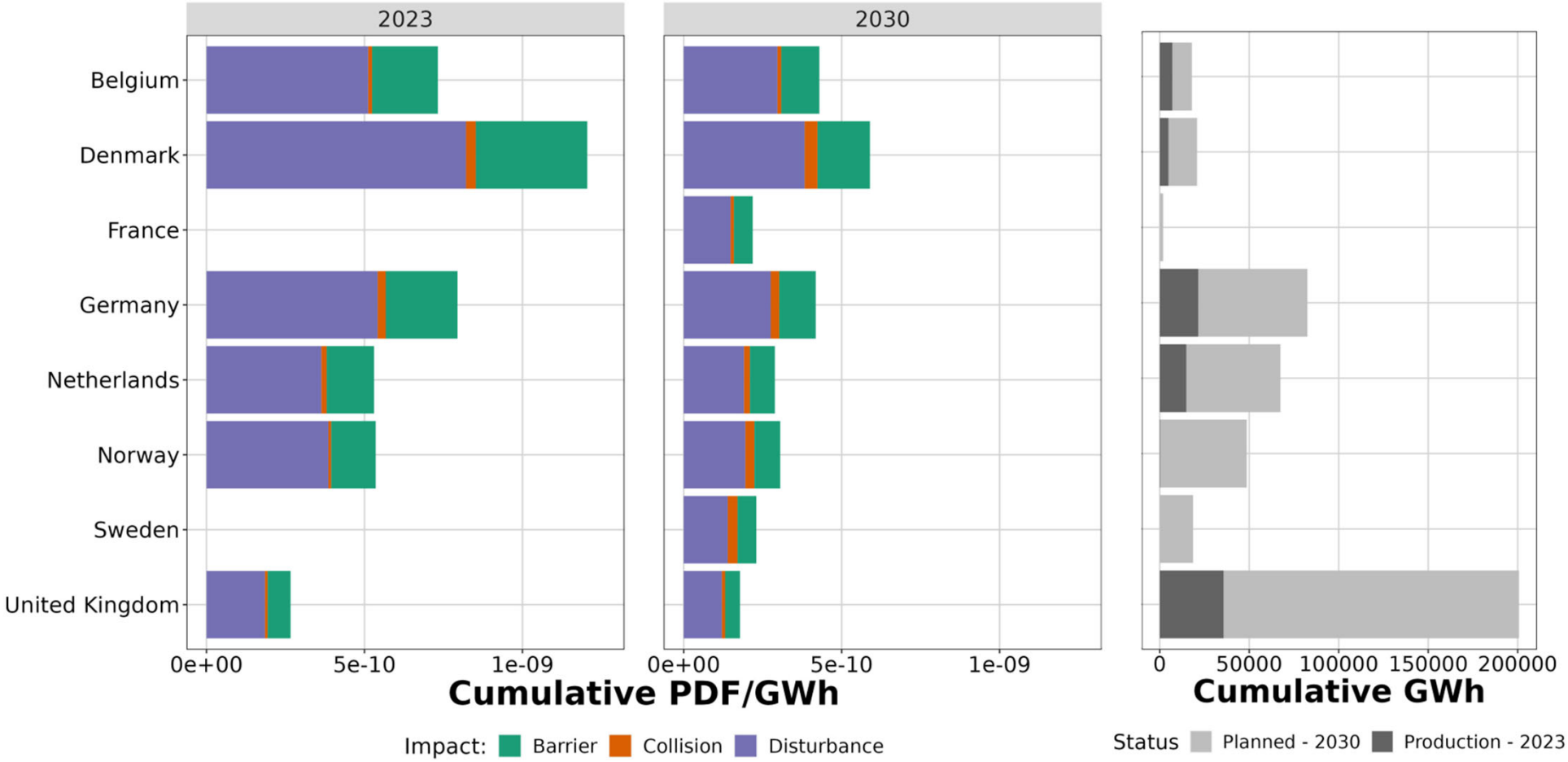

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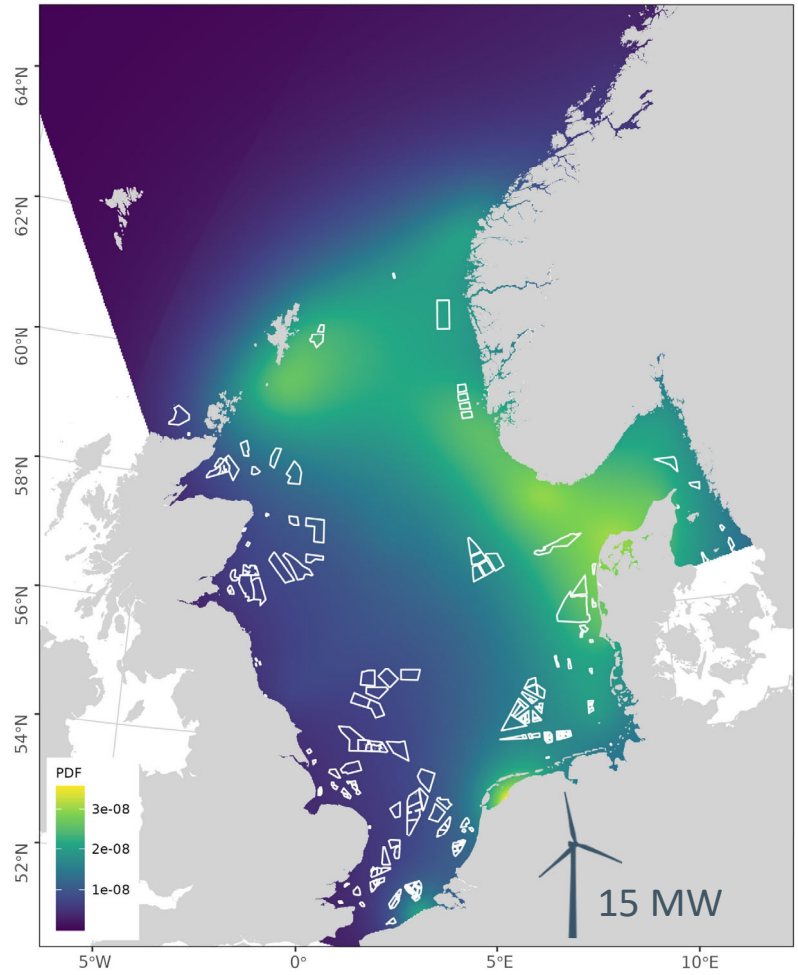
Cumulative PDF map



- Coastal hotspots
  - Waterfowl
  - Waterbirds
- Norway <-> Denmark
  - Waders
  - Raptors
  - Gulls
- Shetland <-> Norway
  - Seabirds
  - Owls

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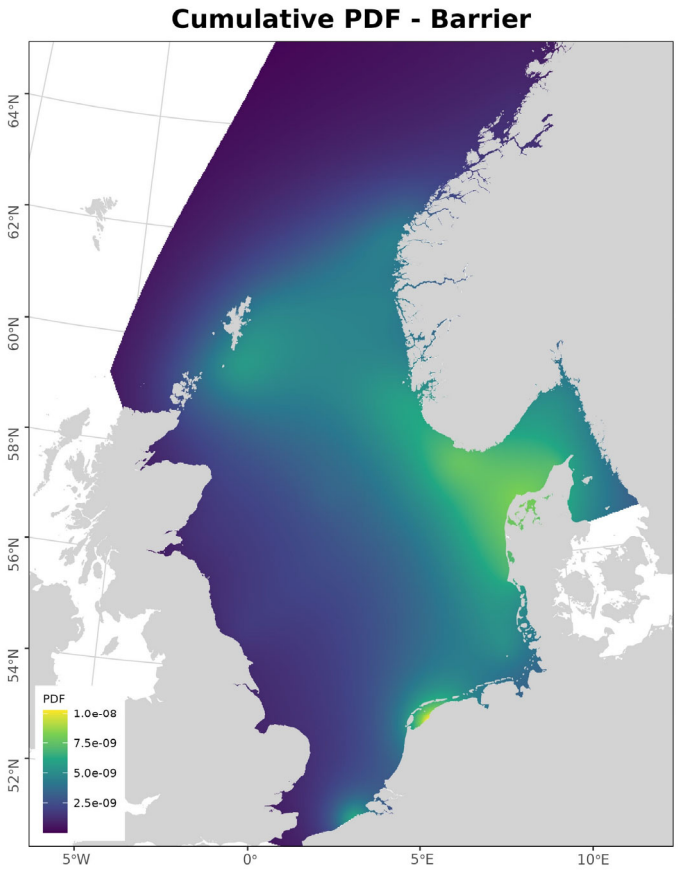
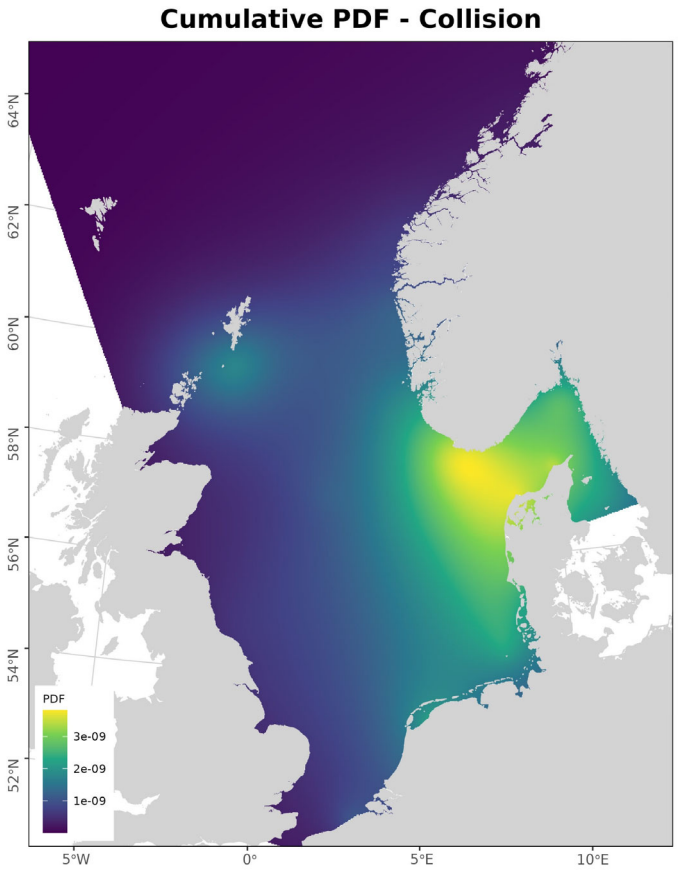
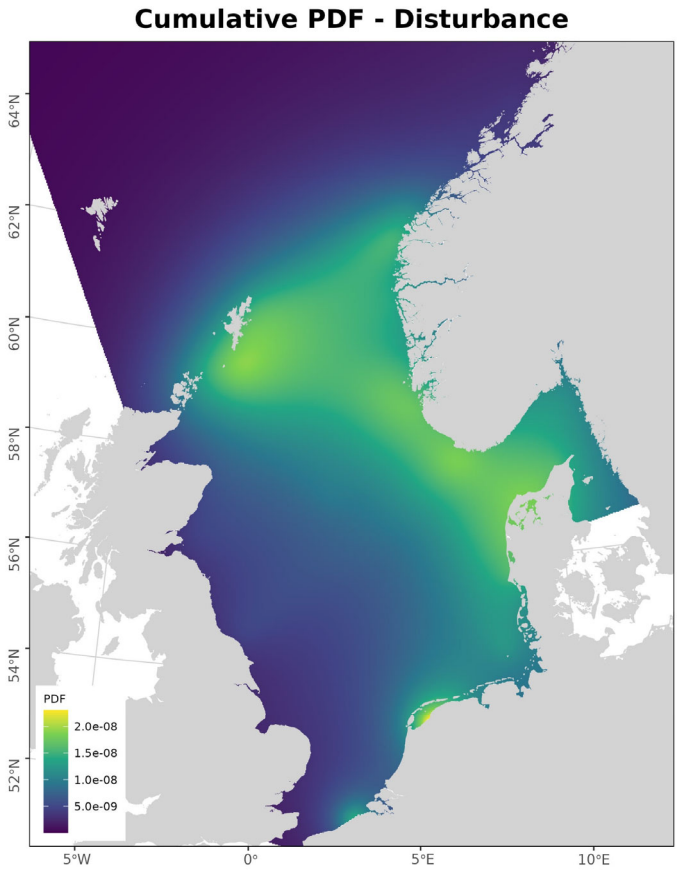
Cumulative PDF maps by impact







Conclusions

Remaining uncertainties

- Lack of data on collisions for some groups e.g. seabirds
- Bias in underlying distributions
  - Ringing and recovering in specific locations
  - Not all species represented
- Distribution validation with tracking data

Conclusions

- Waterfowl, raptors, gulls and waders experience the largest impacts
- Barrier and disturbance effects cause larger impacts than collision for most groups
  - Apart from songbirds
- Importance of impact pathway is location dependent
- Compare PDF values across potential wind farm sites

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MARCIS – Project Collaborators

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SEAPOP
eri environmental research institute
TotalEnergies
UK Centre for Ecology & Hydrology
BarentsWatch
Norwegian Offshore Wind
MAINSTREAM RENEWABLE POWER
RWE
BirdLife NORWAY
HAVFORSKNINGS INSTITUTTET
NORSK·POLARINSTITUTT
OFFSHORE NORGE
NORGES FISKARLAG
NTNU
KYSTVERKET
NVE
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SABIMA
SALMAR Passion for Salmon
Rogaland fylkeskommune
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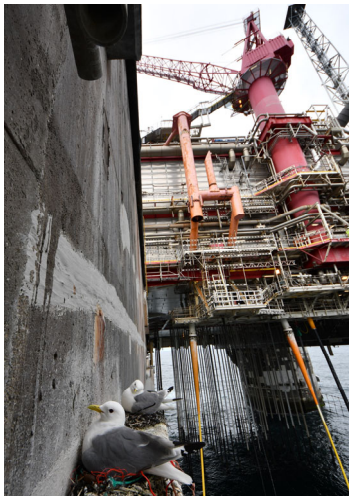
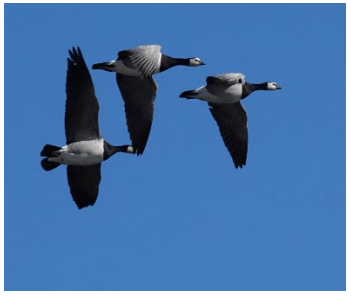
MARCIS is a collaborative research project between research institutes, industry, management authorities, NGOs and interest groups. The project will contribute to ecosystem-based management of marine spatial use and provide a decision-support tool for balancing interests and conflicts in planning processes.





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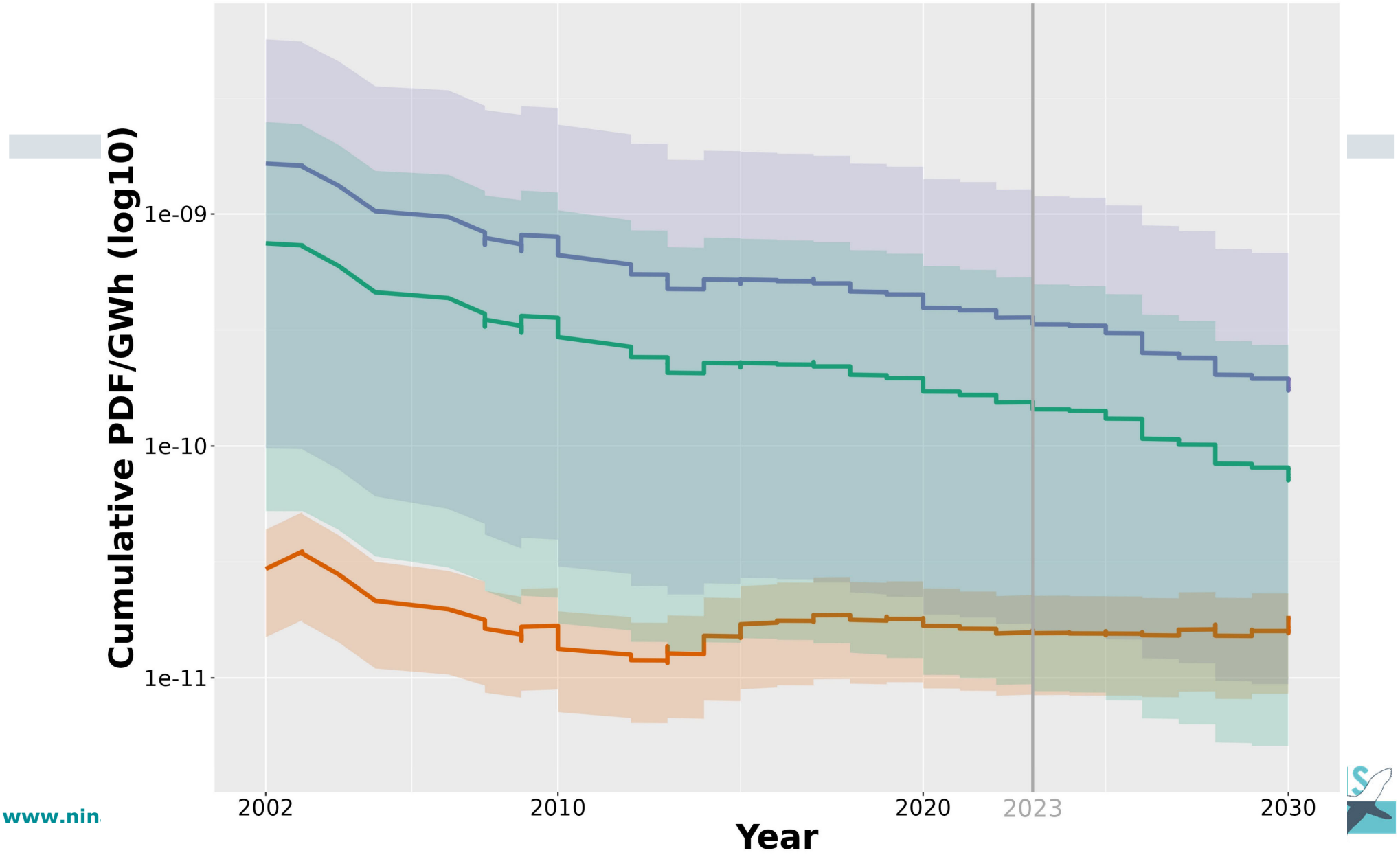
Cumulative PDF/GWh (log10)
1e-09
1e-10
1e-11
2002
2010
2020
2023
2030
Year