

# Marine co-existence and offshore wind developments

Juliette D. Leyris, Ph.D.

Equinor's offshore wind journey

Windfarms in harmony with the environment

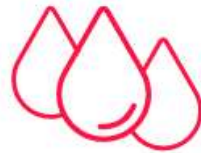
Windfarms in harmony with other sea-users

# Energy production in a climate change context

equinor



Crude oil and natural gas—essential products to keep the wheels of society turning



Processed products: naphtha, condensates, liquids, petrochemicals, wet gas, methane, propane, petrol, diesel



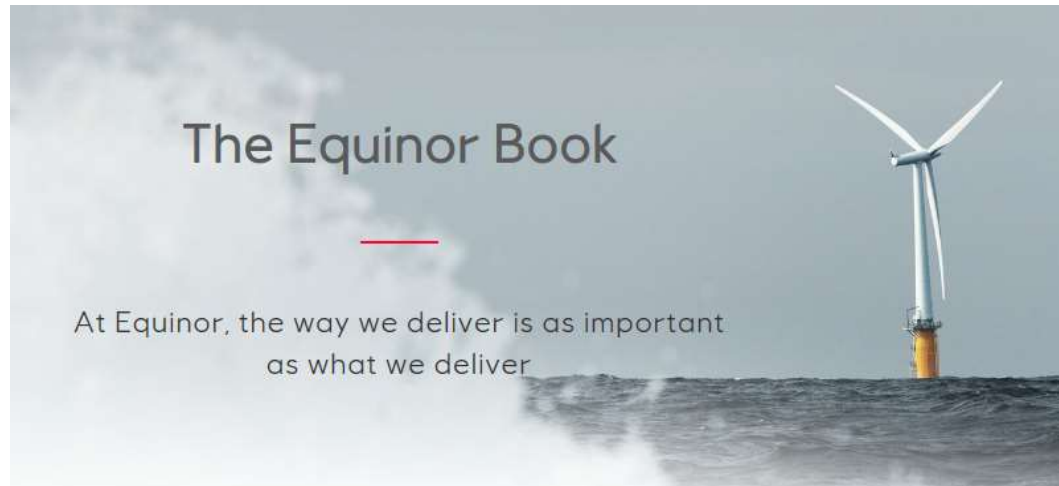
Renewable power being provided for more than 650,000 British homes – with more in development

As the world's population grows and becomes more prosperous, we need to provide **more energy** to heat and light homes, fuel transport and power the economy while **reducing emissions of greenhouse gases**.

# Equinor's wind farms



## Stakeholder management –A key part of **equinor's** commitments



*Equinor : «Our purpose is to turn natural resources into energy for people and progress for society»*

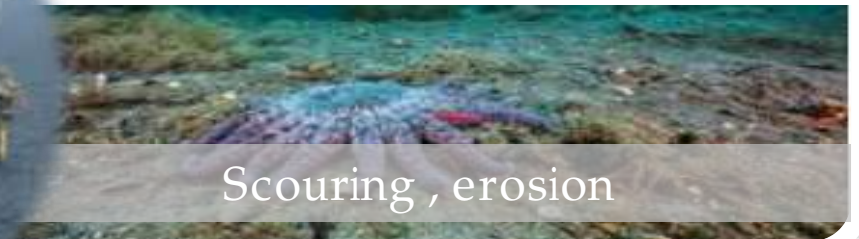


Society and stakeholder engagement :

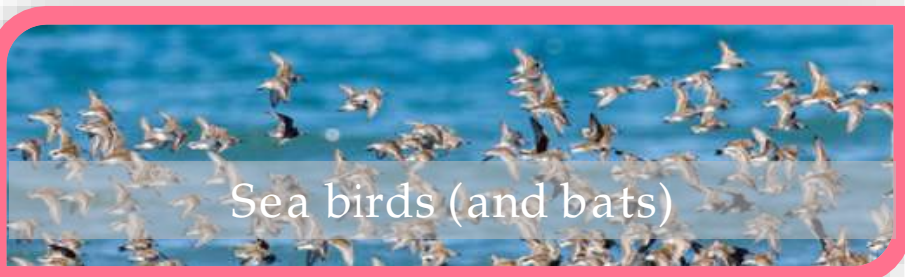
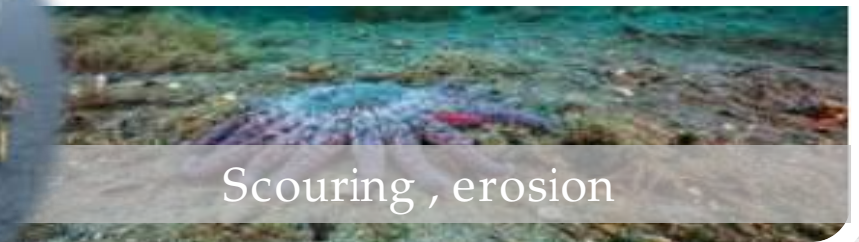
- value creation
- short-and long term competitiveness
- trust and social license to operate

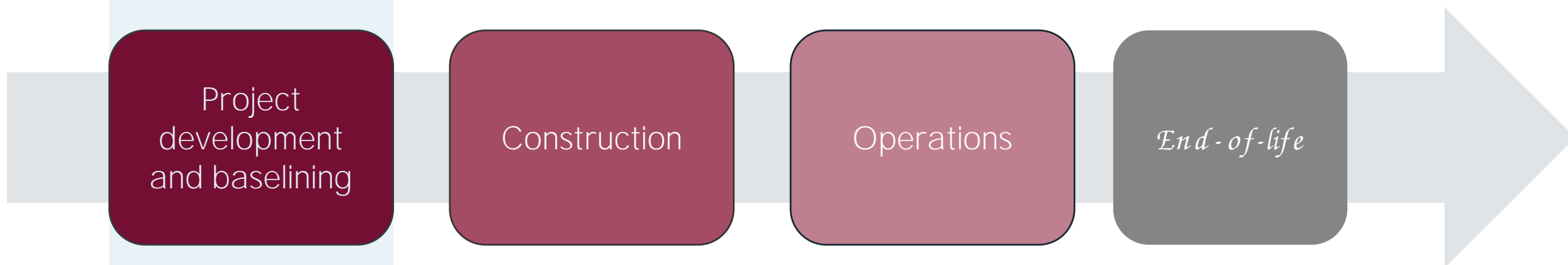
Decisions need to be based on company interests and on interest of societies and ecosystems in which it operates

# Sustainability challenges



# Sustainability challenges





# Baselining

## Why?

- Quantitative estimate of pre-existing environmental conditions (flora, fauna, physical conditions etc.)
- Environmental challenges to be addressed - Impact of the windfarm - Mitigation measures to be planned for
- Basis of future monitoring programs
- Knowledge

## What?

- Sea mammals (seals, whales, dolphins...) - Foraging, reproduction and resting areas
- Birds (and bats) - Migration routes, flight height - Foraging, reproduction and resting areas
- Benthic habitat (corals, sponges etc.) - Sediments quality
- Fish spawning and nursery zones
- Fishing areas

## Who?

- State
- Developer
- State & developer

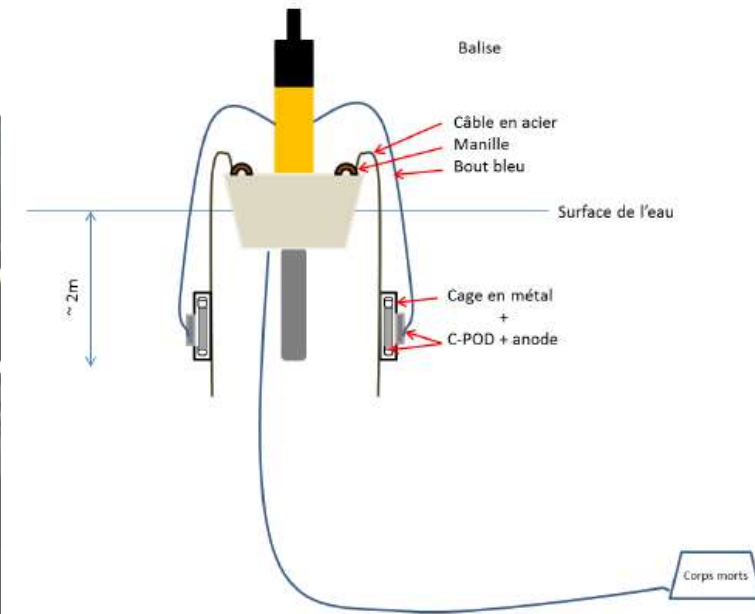
## When?

- As early as possible - Should cover at least 2 reproduction periods. i.e. last at least 18 months

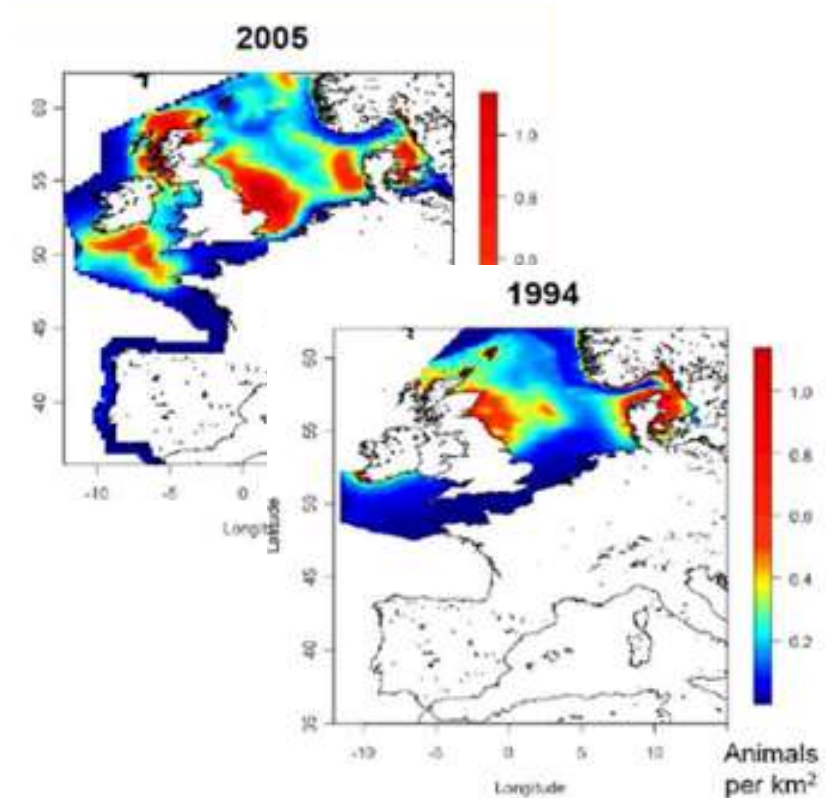
# Baselining

## How?

- Aerial survey of marine megafauna and birds – density and seasonal movements
- Nautical survey of sea mammals and birds – composition and seasonal movements
- Acoustic observation of marine mammals – seasonal and short-time movements



# Baselining



Natural variations in harbour porpoise baselines

- Natural variations will influence the baseline
- TREND: Understanding the reasons for species distribution and variation through habitat modelling could improve the accuracy of future EIA processes and reduce their costs (*under development*)

Each baseline strategy is project specific. It should be based on a preliminary understanding of the challenges at stake and take into account natural conditions and variations.



Project  
development  
and baselining

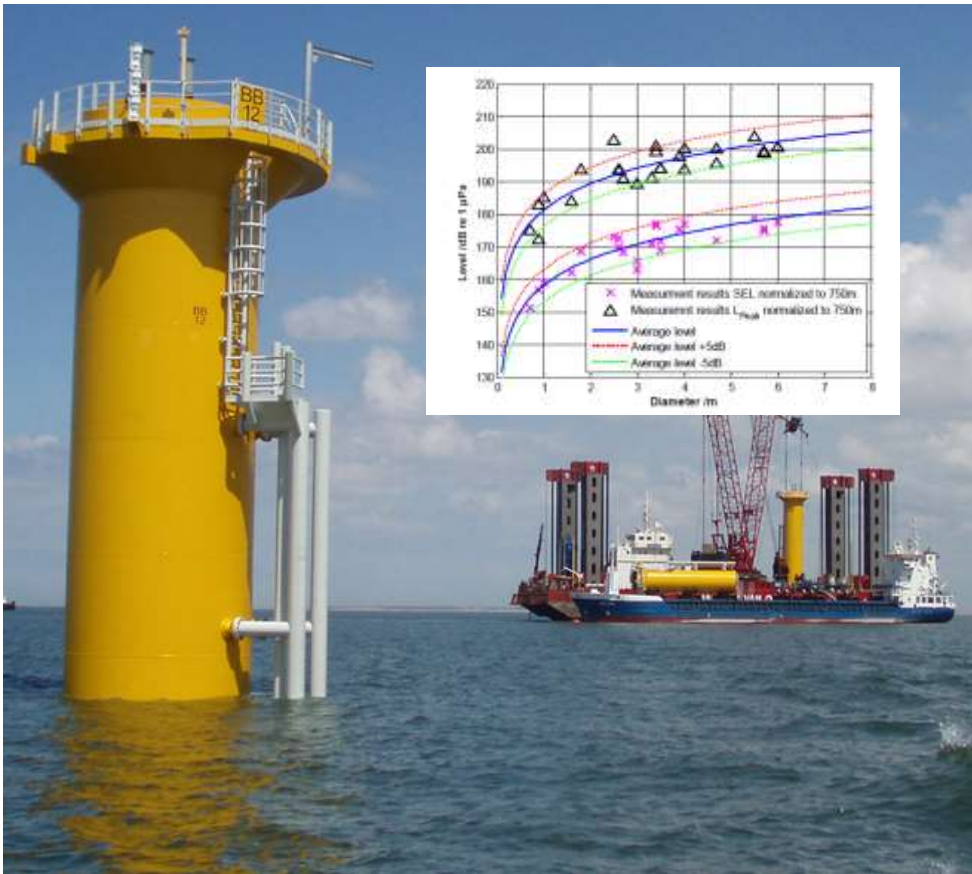
Construction

Operations

*End-of-life*

Sea mammals

# Impact of noise during construction

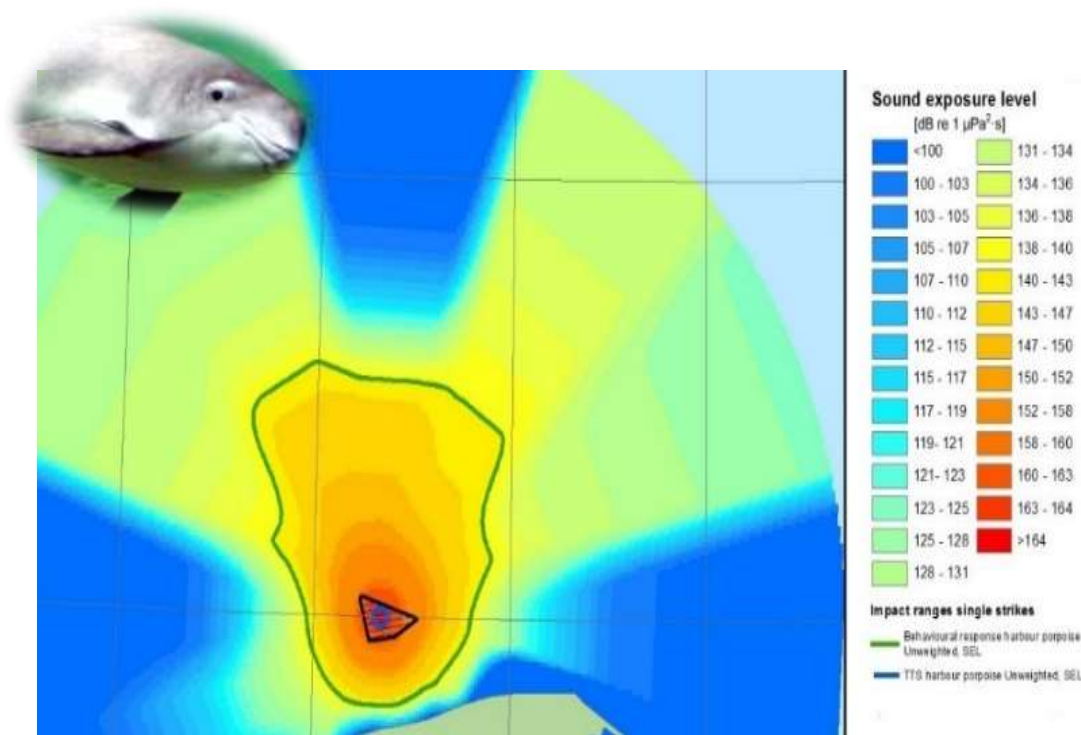


## Pile driving (bottom-fixed installations)

- Turbine shafts hammered into the sea-bed
- Noise spreads through large areas
- Affects species of concern, e.g. marine mammals
- Temporary or permanent audition impairment
- Injuries (individuals), temporary (?) population displacement
- The larger the pile, the louder the piling noise

The impact of noise from pile driving on marine mammals is to be considered for all bottom-fixed installations

# Impact of noise during construction



[Link](#)

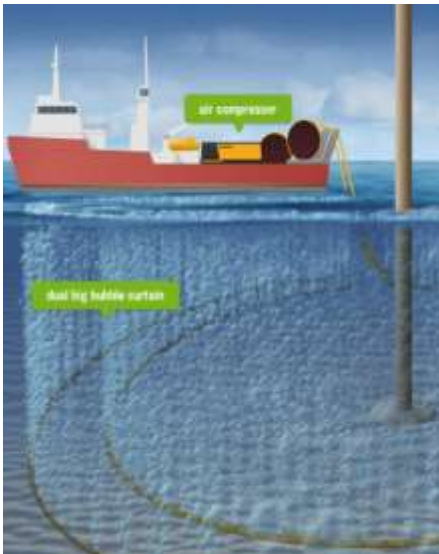
## Impact assessment

- Mapping of the impacted area through noise spreading simulation
- Mapping of cetaceans presence
- Most studies done so far on harbor porpoises (*Phocoena phocoena*)
- Acceptance criteria related to audition  
Temporary Threshold Shift (TTS) and Permanent Threshold Shift (PTS)
- Accumulated impacts: noise from wind farms sums up with noise from ship traffic etc.

For bottom-fixed installations, noise spreading modelling is often included in EIA. Relevant species and cumulated effects should be considered

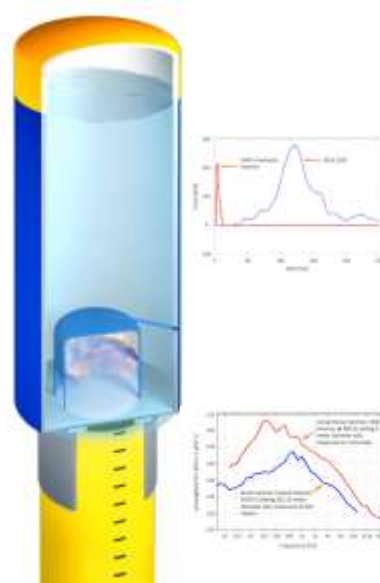
# Impact of noise during construction

Bubble curtain



Noise reduction 5-10dB

BLUE Piling



Noise reduction up to -20dB

## Mitigation measures (bottom-fixed)

- Air-bubble curtains commonly used (expensive)
- «Blue piling»: more progressive energy release (under development)
- Avoid piling- Use jacket with suction buckets, gravity based and drilled foundation (costly and complex)

Noise reduction during installation remains a technical and economic challenge. Acceptable Sound Exposure Levels (SEL) standards can be expected to become stricter.



Project  
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*End-of-life*

Birds and bats

# Operations



## Impact assessment

- Fatalities of birds and bats by direct collision
- Displacement / Modification of migration patterns
  - reduced fitness of birds and bats
  - loss of foraging areas

The impact on birds and bats through collisions, displacement and barrier effect is highly species specific and difficult to quantify.

# Operations

$$\text{Flight activity at rotor height} \times \text{Probability of being hit} \div \text{Avoidance} = \text{Predicted collision rate}$$



## Modelling bird collision through the «**Band model**»

- Model used in the UK
- Assumption : all species flying above lowest wing tip height will be at risk of colliding with the wind turbine
- Very conservative
- Avoidance difficult to estimate

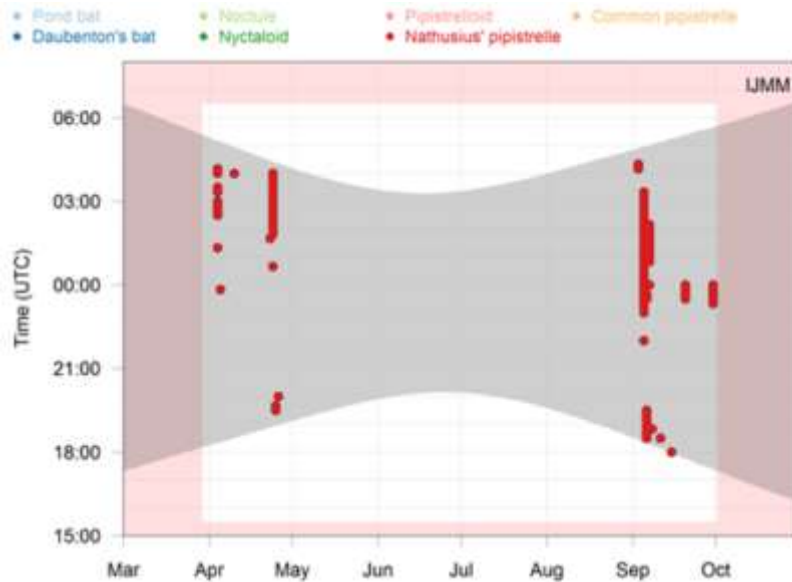
Bird collision modelling is complex and takes a number of variables into account, in particular survey data and avoidance rates.

# Operations



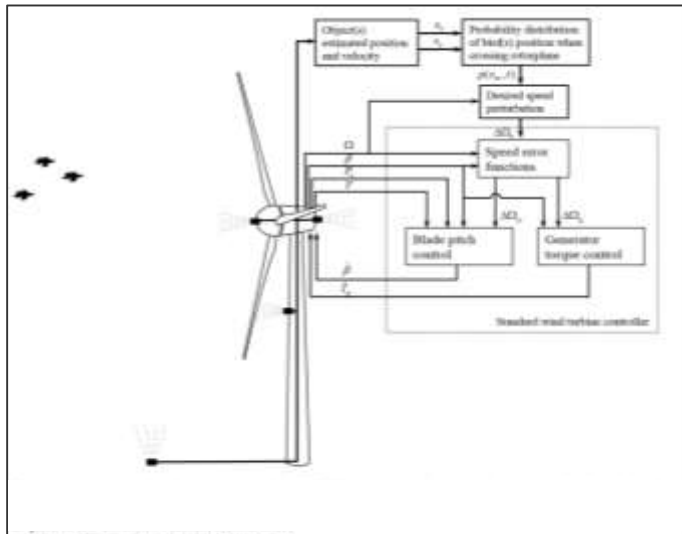
## Bats

- Migration takes place onshore and, to some extent, offshore
- Bat presence at nights under low wind speeds and high visibility conditions
- Seasonal variations
- Barotrauma: a significant number of bat fatalities could be due to internal bleeding caused by rapid changes in atmospheric pressure around operating wind turbine blades.



There are significant knowledge gaps and no consensus yet on the impact of offshore wind installations on bats.

# Operations



**SINTEF «SKARV» system** («Slippe fuglekollisjoner med aktiv regulering av vindturbiner») based on the detection of birds combined with the regulation of the turbine movement- *Under development*

## Collision mitigation measures:

- Lined-up design
- Active regulation of wind turbines : detection of birds and bats on their way to the turbine and regulating turbine speed accordingly (*under development*)
- Limitation of bat-attractive resting place in the turbine structure
- Light management

Collision mitigation technologies are being developed and tested. Equinor is an active partner in those developments.



Project  
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Construction

Operations

*End-of-life*

Fisheries

Fisheries

Fisheries

Fisheries

# Fisheries management : International practices and governance

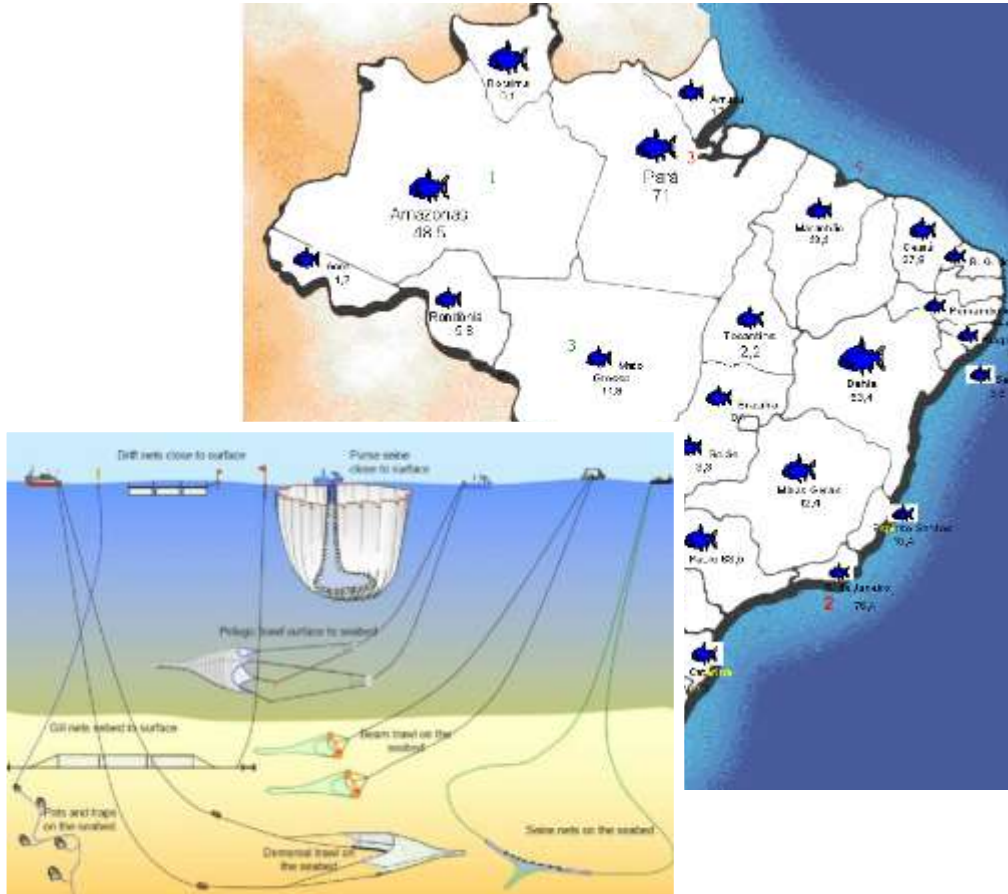


## Guidelines

- UK initiative, FLOWW : *Fishing Liaison with Offshore Wind and Wet Renewables Group*
- Objective : enable and facilitate discussion between fishermen and developers
- Advocate for co-existence, continuous dialogue based on the use of representatives and fact based settlements
- IFC standards

The Scottish guidelines related to fisheries/ windfarm coexistence are widely recognized in Europe and could be adapted to the Brazilian context.

# The different contexts of fisheries management

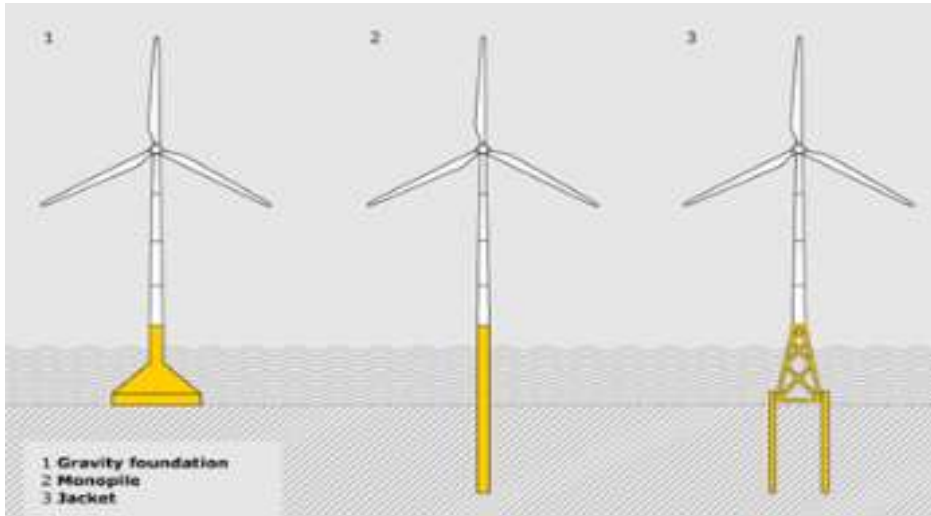


## Parameters

- Fishing activities in the area
- Fishing techniques
- Legal frameworks
- Windfarm sizes
- Turbine technologies
- Local development interests

The management of the interactions between fisheries and offshore winfarms development is highly site specific

# Floating wind vs. bottom-fixed in a fishery management perspective

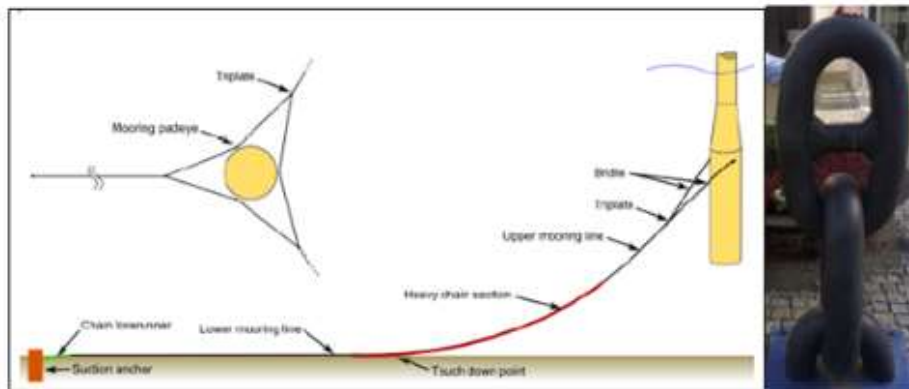


## Bottom-fixed

- Low depth (inshore areas)
- Sediment re-suspension during construction

## Floating (Hywind)

- High depth (offshore areas)
- Free spans and risk of snagging



The choice of turbine technology will strongly impact fisheries management. In all cases, the lay-out (spacing, alignment, positioning) and cable protection / mooring systems should take fisheries interest into account.

# Geographical variations in legal framework and practices



## European legislation

- Germany / Netherlands - No commercial fishing, artisanal fishing/ aquaculture under discussion
- Denmark – Restriction zone 200m each side of subsea cable, no bottom trawling
- France – Artisanal fishing anticipated to be allowed, “lined-up” design
- United Kingdom (Equinor sites) – Commercial fishing not prohibited. Advisory safety zone of 50m around each turbine (under discussion)

The need for a robust co-existence framework for the different users of the sea is growing. New legislations support this trend.

## Engaging with fishermen



*Project Mar Atento, Basin Campo coast, Brazil,  
2017, equinor*

### Engaging at every project stage - examples

- Wind farm design and location adjustment
- Use of fishing boats during surveys
- Emergency preparedness and response training
- Sharing of metocean data

### Compensation to fishermen

- Project specific
- Compensation of fishermen for documented losses due to survey and/or construction activities
- No direct long term compensation during operations
- Community funds

Close dialogue and early engagement with local fishermen is key. Coexistence is always preferred.

To conclude....



- Impact of noise on sea- mammals during construction
- Impact on birds (and bats) during operations
- Each project will have its social and ecological specificities and will require specific solutions
- Fishermen : key stakeholder of windfarm developers to be involved at all stages for a good co-existence at sea

As it offshore wind journey is starting, Brazil will benefit from international best practices, guidelines and experience. In addition, tailored solutions will have to be developed to fit the country national ecological and social context.

# Obrigada pela atenção!

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