



A 'positive' experience from Great Britain and Northern Europe: Best Practice in Offshore Wind Farm environmental impact assessment

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Who are Cefas?

- The Centre for Environment, Fisheries and Aquaculture Science;
- Executive agency of the Department for Environment, Food and Rural Affairs (Defra);
- Fully accountable to Parliament;
- Provide evidence-based scientific advice, manage related data and information, conduct scientific research, and facilitate collaborative action through wide-ranging international relationships; to
- Secure healthy marine and freshwater environments for society's well-being, health and prosperity;
- Work areas include: observing and modelling, Marine Climate Change Centre, ecosystems and biodiversity, animal health and food safety, fisheries management, assessing human impacts;
- Work nationally (regulatory & policy advice, research, monitoring) and internationally (ICES, OSPAR, London Protocol ect)

Who am I?

- 17 years experience of marine environmental impact assessment (13 leading work on offshore renewable energy developments) – Scientific advisor to Marine Management Organisation, Welsh Government & Defra;
- Member of the (now defunct) COWRIE steering group (commissioning research into environmental effects of offshore wind farms);
- Member of the UK Energy Strategic Environmental Assessment steering group;
- Co-author of the OSPAR Current State of Knowledge of the Environmental Impacts of the Location, Operation, and removal/Disposal of Offshore Wind Farms – Status Report 2006 (2013/14 revision in prep);
- Co-author of the OSPAR Guidance on Environmental Considerations for Offshore Wind Farm Development (2008);
- Lead author of the Guidelines for data acquisition to support marine environmental assessments for offshore renewable energy projects (2012);
- Co-chair of the OSPAR working groups on cumulative effects and underwater noise.

What am I doing here?

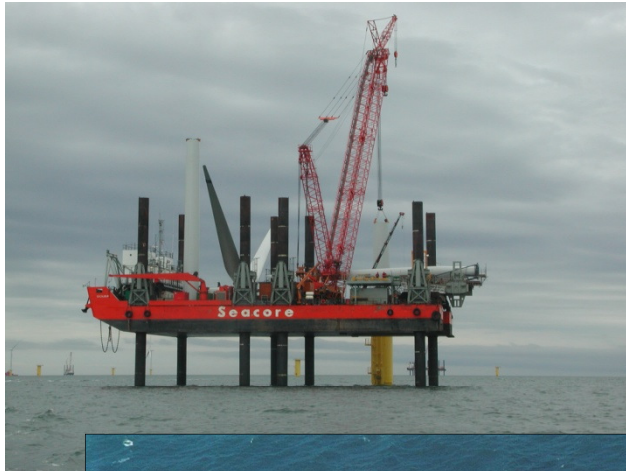
- Share knowledge and experiences from UK & OSPAR on assessment of environmental effects of offshore wind farms (construction and operation);
- Learning by doing;
- Not all positive!



Useful websites

- http://www.ospar.org/documents/dbase/publications/p00278/p00278_owf%20knowledge%20of%20env%20impacts.pdf
- http://www.ospar.org/v_measures/get_page.asp?v0=08-03e_Consolidated%20Guidance%20for%20Offshore%20Windfarms.doc&v1=5
- <http://www.marinemanagement.org.uk/licensing/groups/documents/orelg/e5403.pdf>
- <http://infrastructure.planningportal.gov.uk/application-process/the-process/>
- <http://www.marinemanagement.org.uk/>
- <http://www.scotland.gov.uk/Topics/marine/marineenergy>
- <http://www.thecrownestate.co.uk/energy-infrastructure/>
- <http://www.cefas.defra.gov.uk/our-science/assessing-human-impacts/offshore-renewable-energy.aspx>

Do offshore wind farms differ from other human activities in the marine environment? Answer: No



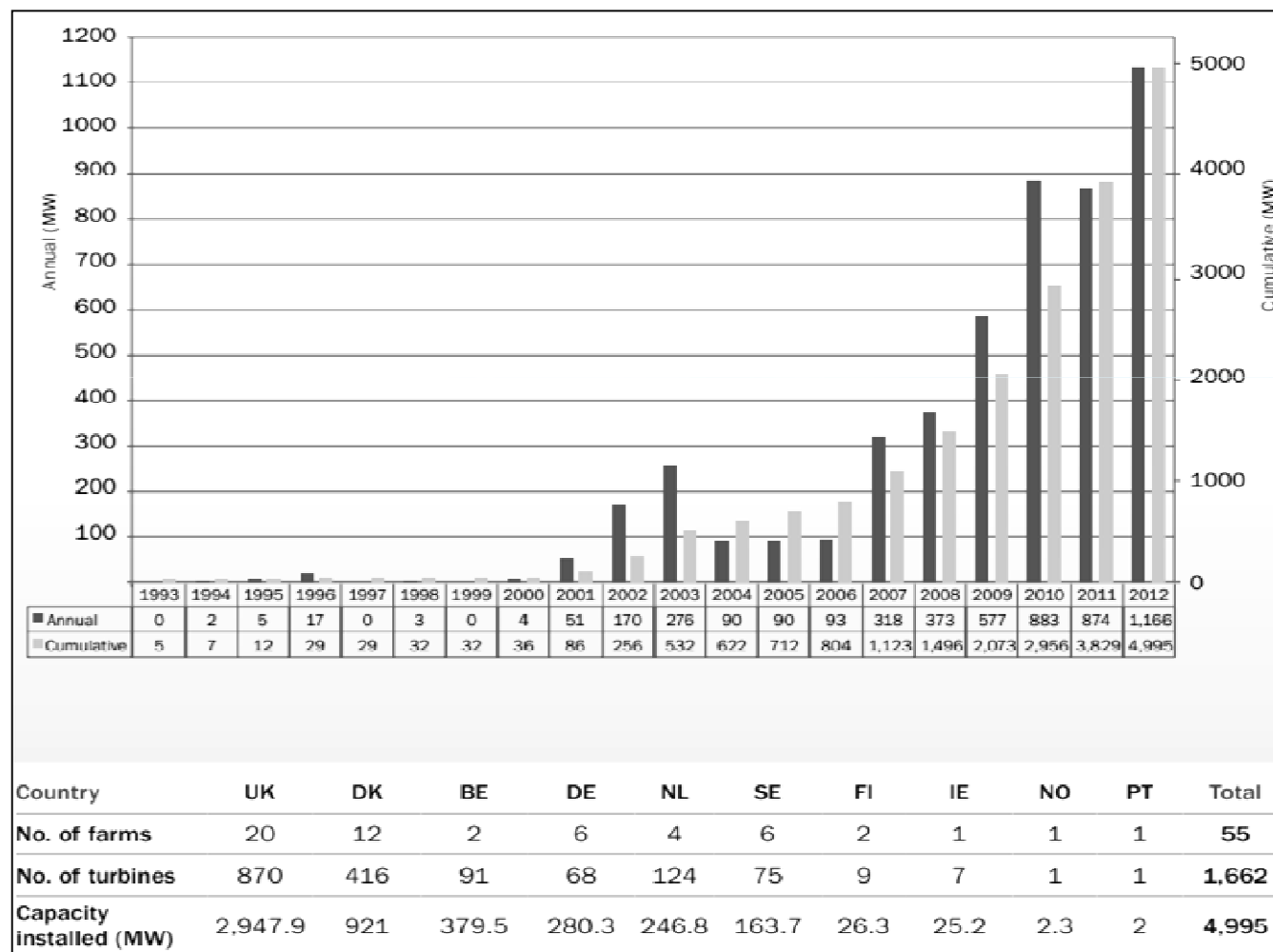
But at a much larger scale
Some key issues requiring resolution

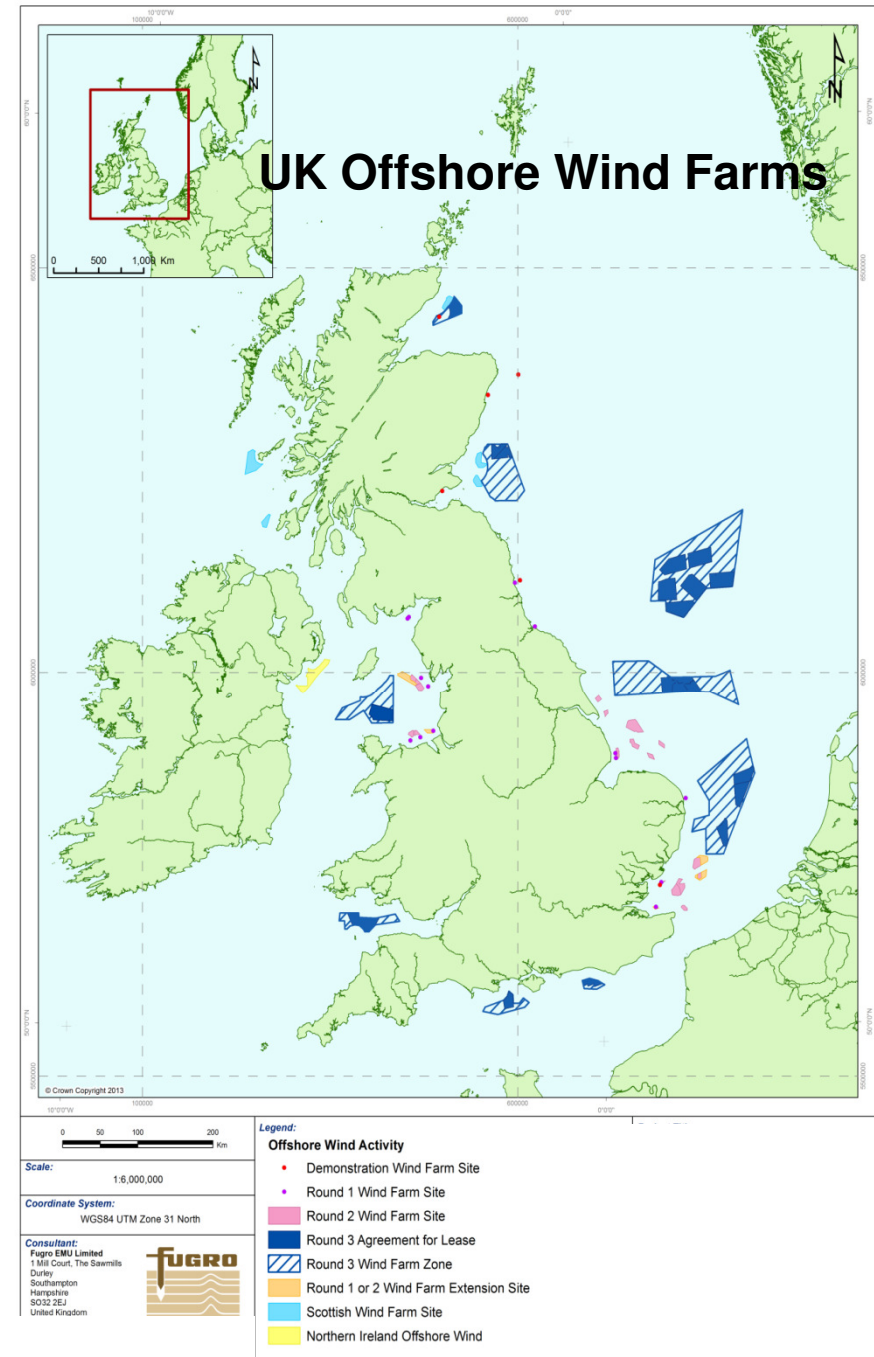
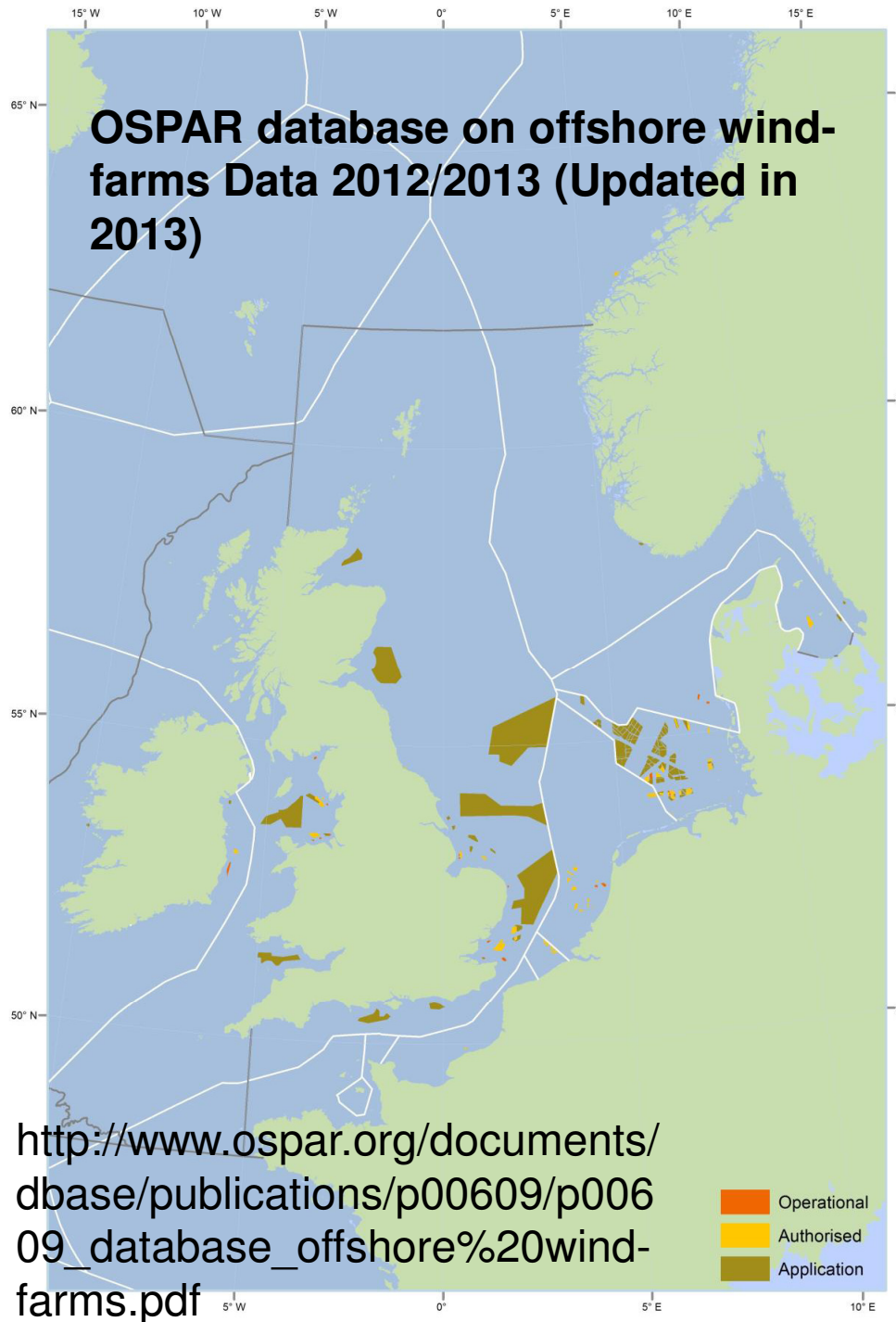
Knowledge & understanding

- Relatively new industry so few peer-reviewed articles (but body of evidence is increasing);
- Most materials and impacts not unique to offshore wind farms;
- Draw on existing knowledge (oil & gas, aggregate extraction, coast protection, port developments etc);
- Much of our understanding and knowledge emerging from environmental impact assessments and government sponsored research (national & international);

Cumulative and annual offshore wind installations (MW) from 1993 to 2012

(Source: EWEA)





UK approach

- UK target 15% of energy from renewable sources by 2020
- OWF key role in meeting these targets
- UK Offshore Energy Strategic Environmental Assessment
- Developers have to lease the seabed from The Crown Estate
- Leasing Rounds

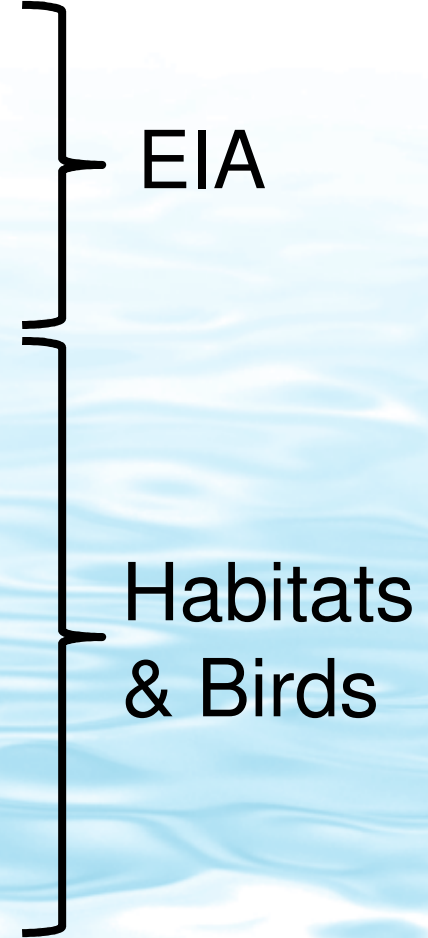
Round	Potential Capacity (GW)	Number of Sites
1	1.2	13
2	7.2	17
2.5 (extensions to R1 & R2)	1.5	6
3	33.0	9 (zones)
Scottish territorial waters	4.8	5

- Round 3 different approach, 'development zones' may yield multiple development applications in a phased approach

Key EU environmental legislation

- Council Directive No 85/337/EEC as amended on the assessment of the effects of certain public and private projects on the environment (the EIA Directive);
- Council Directive 92/43/EEC on the conservation of natural habitats and of wild flora and fauna (the Habitats Directive);
- Council Directive 2009/147/EC on the conservation of wild birds (the Birds Directive).

Key UK environmental legislation

- Marine & Coastal Access Act 2009
 - Planning Act 2008 (as amended)
 - Conservation of Habitats and Species Regulations 2010 (as amended)
 - Offshore Marine Conservation (Natural Habitats &C.) Regulations 2007 (as amended)
- 
- The diagram uses brackets to group the legislation into two categories. A bracket on the right side of the first two items (Marine & Coastal Access Act 2009 and Planning Act 2008) is labeled 'EIA'. A bracket on the right side of the last two items (Conservation of Habitats and Species Regulations 2010 and Offshore Marine Conservation Regulations 2007) is labeled 'Habitats & Birds'.

Marine & Coastal Access Act 2009

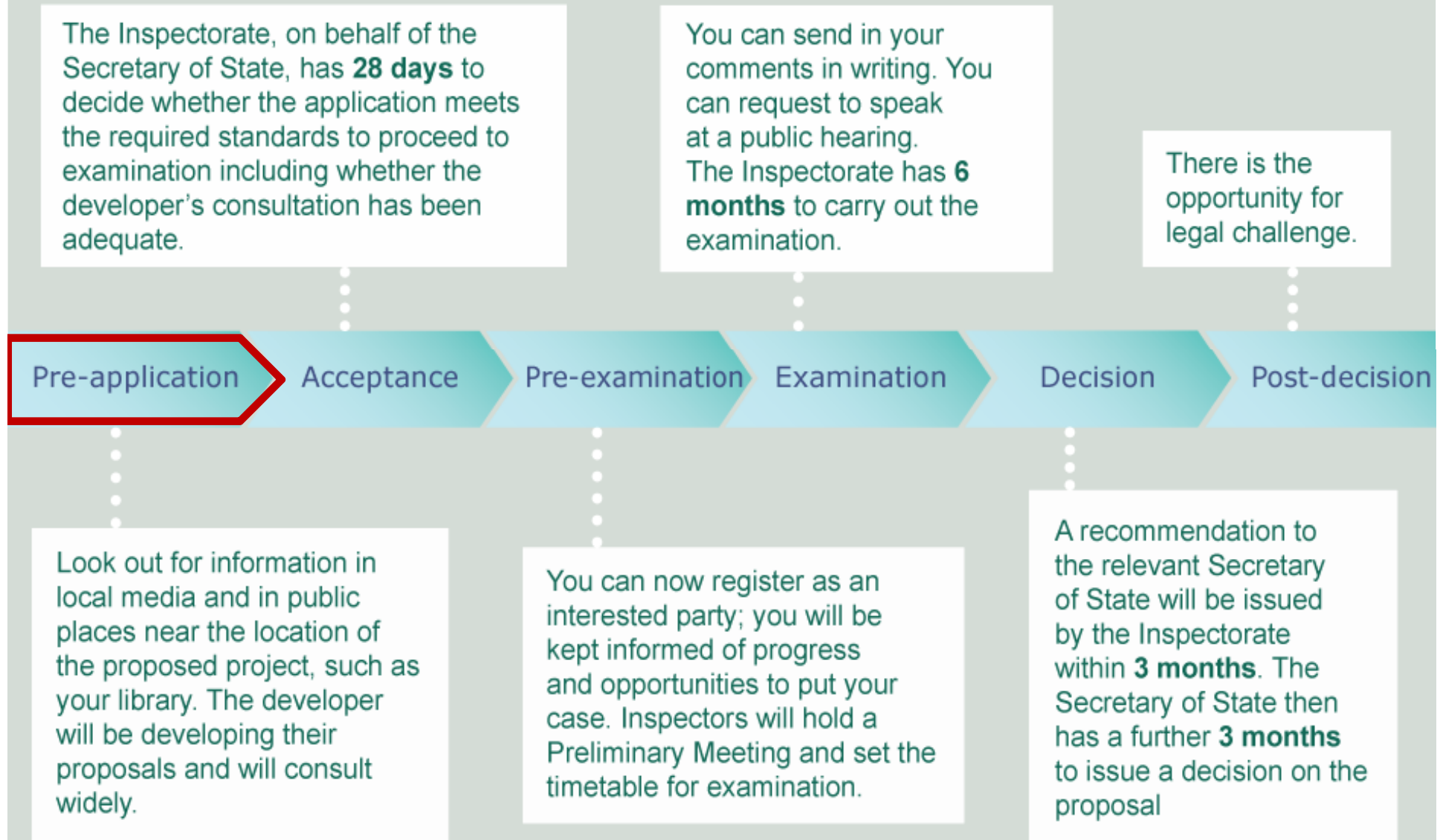
- Replaced the Food & Environment Protection Act 1985
- Created the Marine Management Organisation (England)
- New system for marine planning
- Streamlining UK Govt regulatory regimes for certain marine activities, simplifying the process and ensuring sustainable development
- Establishment of a network of marine protected areas / marine conservation zones (habitats & species)
- Licensing of OWFs <100 MW (England & Wales), also options under section 36 of the Electricity Act 1989
- Licensing all OWFs (Scotland and Northern Ireland)

Planning Act 2008

- Streamline the approvals process for new nationally significant infrastructure projects (includes OWF >100 MW) for projects in England and Wales
- Overseen by the Planning Inspectorate (recommendation to the Sec of State)
- In England (Marine Management Organisation) and Wales (Natural Resources Wales) consultee (interested party), providing advice during the application process
- If approved – Deemed Consent Order (including licence) issued – MMO & NRW responsible for enforcement

The application process. The six steps

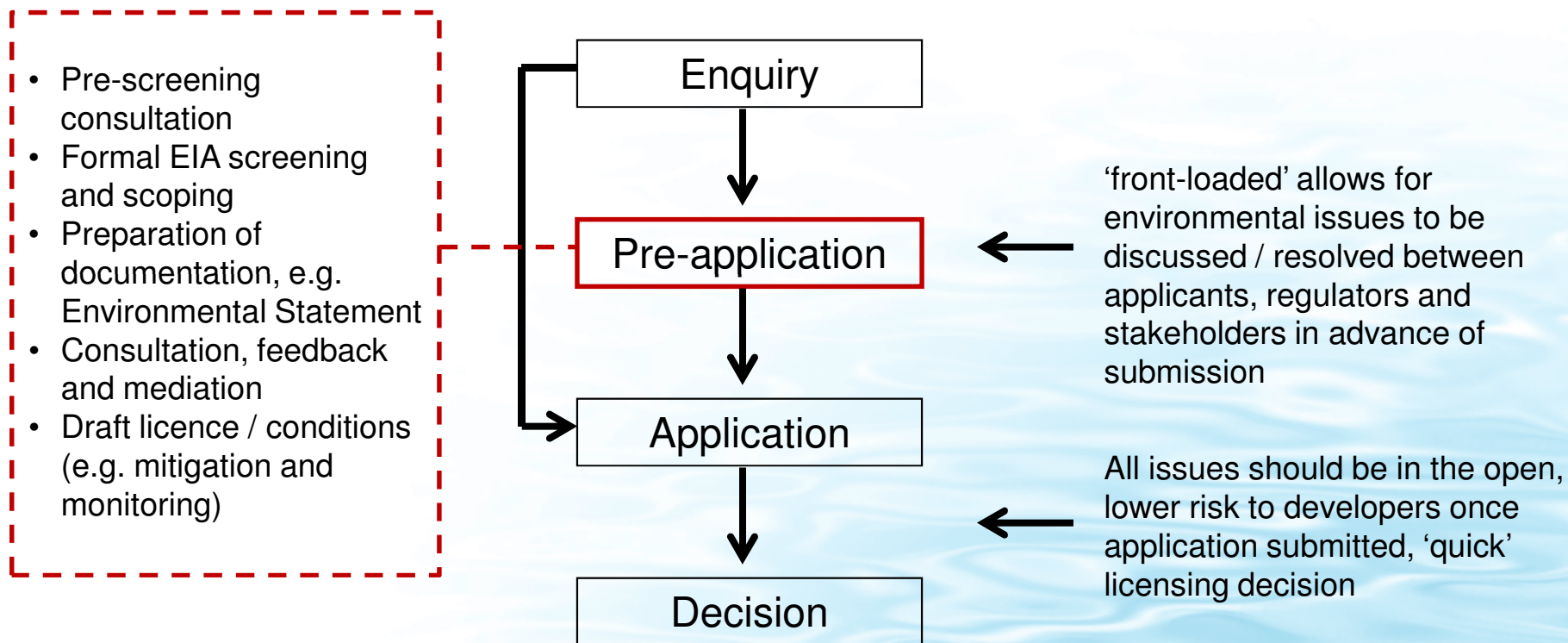
Planning Act 2008



Pre-application

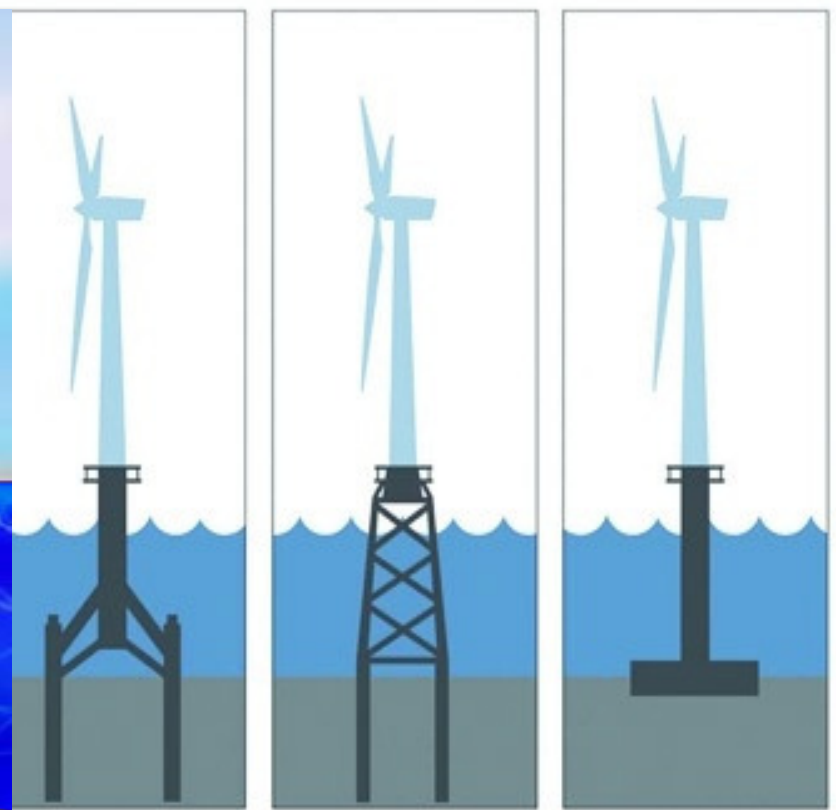
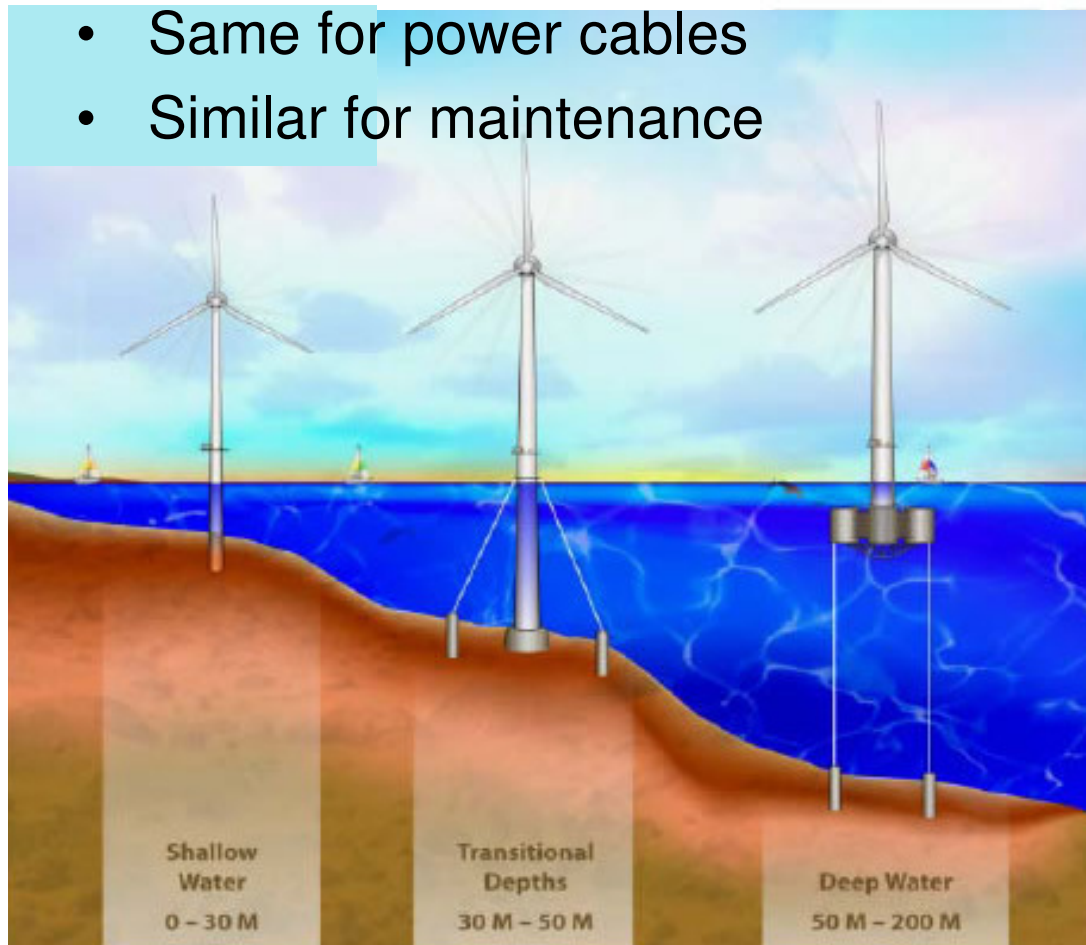
- Developer extensive consultation on proposals
- statutory and non statutory bodies and the wider community
- Statement of Community Consultation (SOCC)
- Responding to questions, listening to suggestions, and taking these into account to influence and inform the application
- Open audit trail of all communications
- Environmental Impact Assessment

Simple overview process for Marine & Coastal Access Act 2009



Environmental impacts

- Different for construction, operation and decommissioning
- Different for foundation / anchor types
- Same for aerial components
- Same for power cables
- Similar for maintenance



Environmental impacts



Birds, e.g. collisions (injury / mortality); disturbance / displacement (habitat loss); barrier effects (migration / feeding & breeding)

Human users, e.g. ships and aeroplanes (radar interference and navigation hazard); displacement fishing activities

Fish & marine mammals, e.g. underwater noise; suspended sediments; electromagnetic fields; collisions; fish aggregation

Benthos, e.g. habitat loss & disturbance (scouring, new substrate, cable laying, scour / cable protection)

Environmental impacts

Construction activities: • Noise

Decommissioning:

- Suspended sediments
- Disturbance (construction plant movements)

Physical presence:

- Habitat loss
- Hard substrate (foundations & scour protection)
- Barrier effects (birds, marine mammals, fish)
- Collision (birds, marine mammals)
- Hydrodynamics, sediment transport, coastal erosion
- Other users (access & navigation)

Operation:

- Noise
- Electromagnetic fields
- Disturbance – maintenance activities

An aerial photograph of an offshore wind farm. Numerous white wind turbines with yellow bases are arranged in several rows across a deep blue ocean. A white wake or path of churning water extends from the bottom right towards the center of the farm. The sky is blue with some light clouds. The text "Environmental impacts" is overlaid in white.

Environmental impacts

Construction noise

- Needs knowledge of acoustics / physics and physiology / ecology
- Drilling and dredging - relatively low (equivalent to shipping activities)
- Ramming / driving – high (SPL levels up to 235 dB_{p-p} re 1μPa @ 1m recorded)
- Key receptors – fish & marine mammals
- Mortality and injury – close to source
- Disturbance – tens of Km from source
- Temporal and seasonal restrictions
- Mitigation measures under development / testing (e.g. cofferdams; bubble curtains; isolation casings; screens; reduced energy; cushions)

Noise metrics

There are currently no international standards for the measurement of underwater noise from the construction or operation of an OWF. The International Organization for Standardization (ISO) currently has a work item under Technical Committee (TC) 43, Sub-Committee (SC) 3, Working Group (WG) 3, to produce a measurement standard for the 'Measurement of radiated noise from pile-driving', which should be available before 2016. TC43-SC3-WG2 is also working towards a standard on 'International Standard for Underwater acoustical terminology', which will also be relevant to any underwater noise measurement.

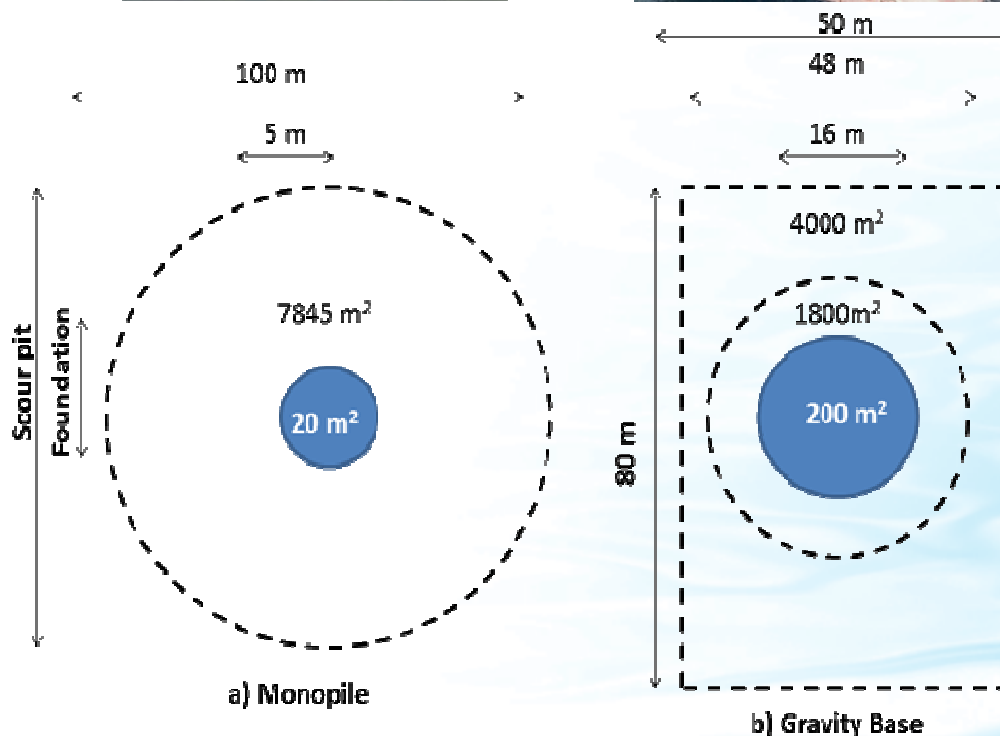
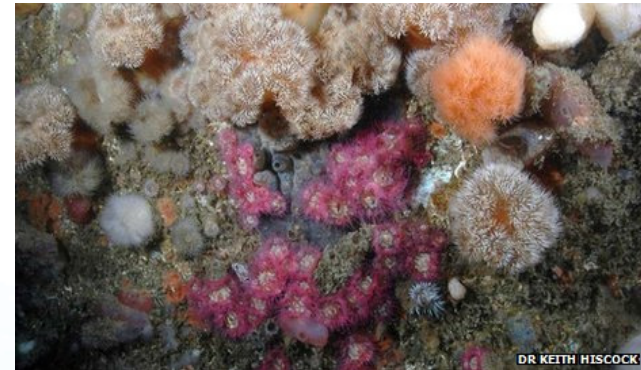
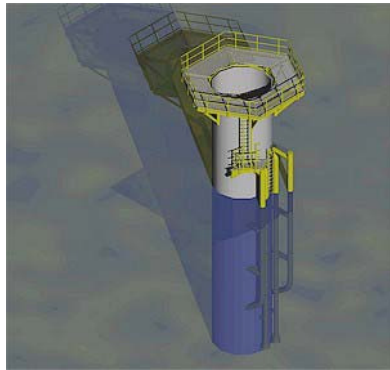
Suspended sediments

- Only an issue during construction / maintenance
- Cable laying, dredging, scouring, vessel movements / anchoring
- Short-lived and near-field
- In turbid waters indistinguishable from background
- Only an issue if sensitive receptors present (e.g. sessile benthic organisms; filter feeders) or bathing waters

Construction / maintenance vessels

- Disturbance and injury
- Pollution incidents
- Fish, marine mammals and birds
- Mitigation: plan routes / timing to avoid sensitive locations; Environmental Management Plans
- Seal mortality 'corkscrew' injuries(a description of the wound likely caused by animals being rotated past a propeller) (Thompson, *et al.* 2010) for vessels using cowled or ducted propellers

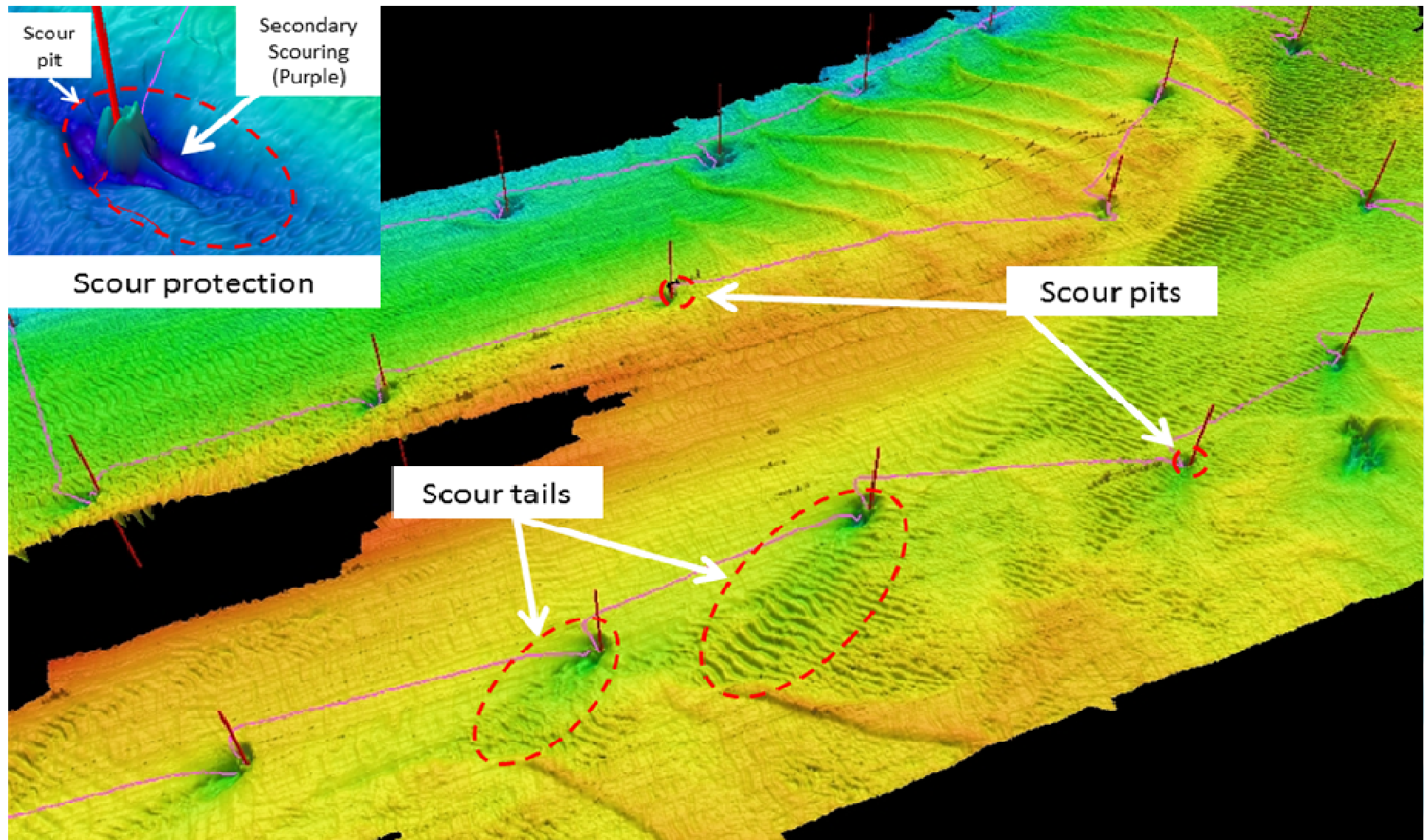
Habitat loss / change



Not to scale

- Colonisation of foundations and scour protection
- Some difference to indigenous biota
- Steel more species-poor than concrete
- Non-indigenous species – ‘stepping stones’
- Organic debris – anoxia
- Fish aggregation

Habitat change



Barrier effects

- Migratory species: fish, marine mammals birds
- Roosting areas to feeding / breeding grounds
- Physical obstruction (blades, towers, scour protection)
- Physiological / behavioural (noise, electromagnetic fields)
- Disturbance, e.g. birds spending extra time and/or energy to avoid structures or human activity
- Displacement, e.g. reduced number of birds occurring within or immediately adjacent to OWFs

Collision

- Birds with turbine blades
- Critical factors: flight height (e.g. passerines & geese fly above turbines) and number of passages
- Gulls, eagles, gannets, skuas and kittiwakes most at risk (Furness *et al* 2013; May *et al* 2010)
- Lindeboom *et al* 2011: gannets, scoters, auks and divers greater avoidance than cormorants, terns and gulls which foraged within the OWF
- Greater risks at night or poor visibility (e.g. fog)
- Few methods available to measure / quantify collisions
- Standardized collision risk model (Band, *et al* 2012)
population dynamics model (Poot, *et al* 2011)

Operational noise

- Ambient underwater noise is subject to large variation due to environmental, seasonal and anthropogenic factors
- Operational noise is generally of low level comparable with ambient noise within a few hundred metres of the foundation (Nedwell *et al.*, 2007; Nedwell *et al.*, 2011, Tougaard *et al.*, 2009; Wahlberg and Westerberg, 2005)
- Operational noise is unlikely to result in a significant impacts on marine fauna

Electromagnetic fields

- From power cables
- Three components: electric field; magnetic field and induced electrical field (Gill *et al* 2005)
- Electric fields shielded in most standard cables
- Magnetic field detectable outside the cable
- Magnetic field induces a second electric field outside the cable
- Burial does not 'switch-off' the fields but provides a physical barrier to strongest (repellent) fields
- Some receptors (e.g. sharks, skates and rays) may be attracted to the lower level emissions
- Significance of effect (if any) still unknown

Coming soon!

- UK Review of Post-Consent Offshore Wind Farm Monitoring Data Associated with Marine Licence Conditions
- OSPAR Update on the Current State of Knowledge of the Environmental Impacts of the Location, Operation and Decommissioning of Offshore Wind Farms – Status Report 2013/14

Grazie! Domande?

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"What giants?" asked Sancho Panza.

"Those you see over there," replied his master, "with their long arms. Some of them have arms well nigh two leagues in length."

"Take care, sir," cried Sancho. "Those over there are not giants but windmills. Those things that seem to be their arms are sails which, when they are whirled around by the wind, turn the millstone."

Extract from The Adventures of Don Quixote de la Mancha (1615)