Descriptor 11

Underwater Noise: a novel and challenging aspect of Good Environmental Status

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Chair of TG11
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JNCC
Joint Nature Conservation Committee

Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment

Descriptor 11

What is “adversely affect”

Harbour porpoises move away from pile driving during wind-farm installation

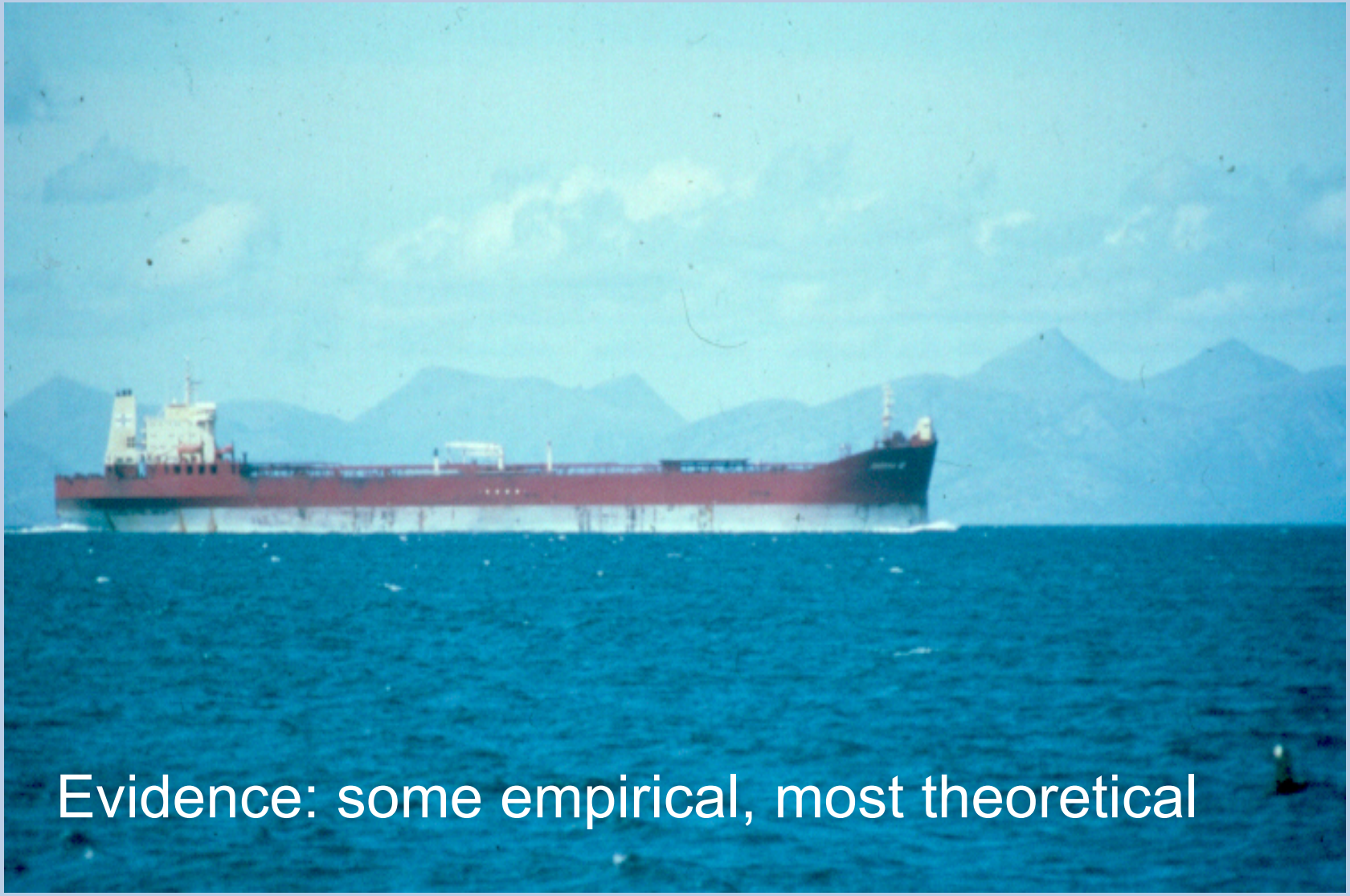
Most cetaceans move away and change behaviour near active seismic vessels

Fish respond to pile driving and seismic survey at short range

Beaked whales strand (probably caused by behavioural change leading to the ‘bends’) near naval mid-frequency sonar

Known effects

Communication difficulties caused by low frequency noise

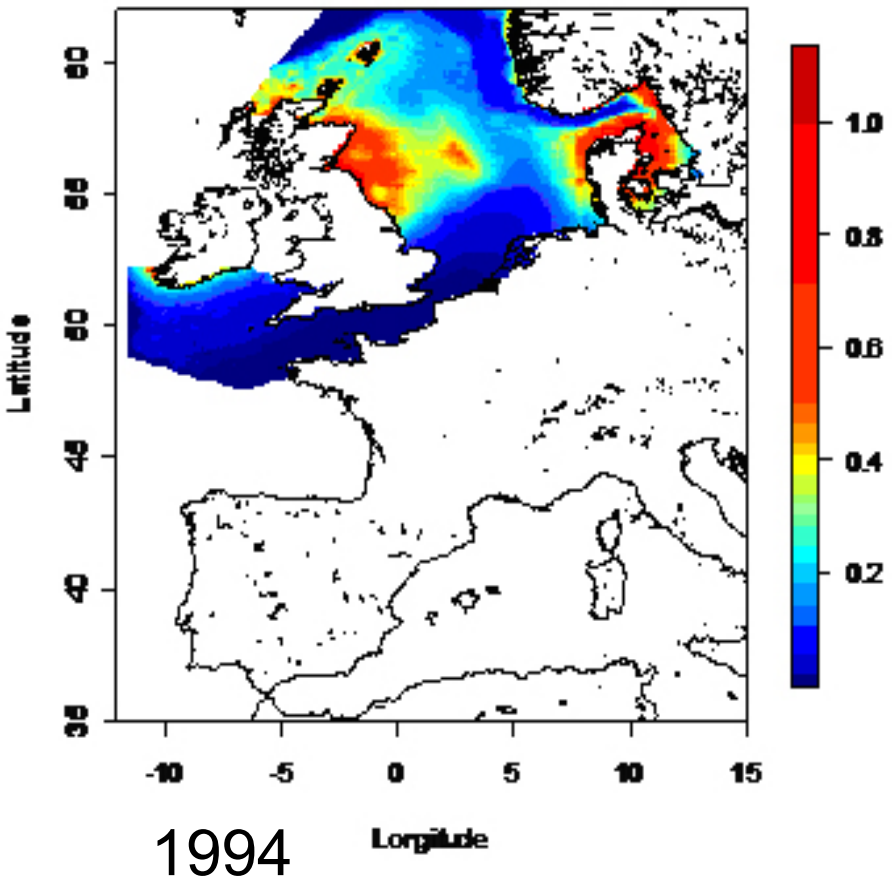


Lack of predictability in effects

Bill Hall, Caltrans

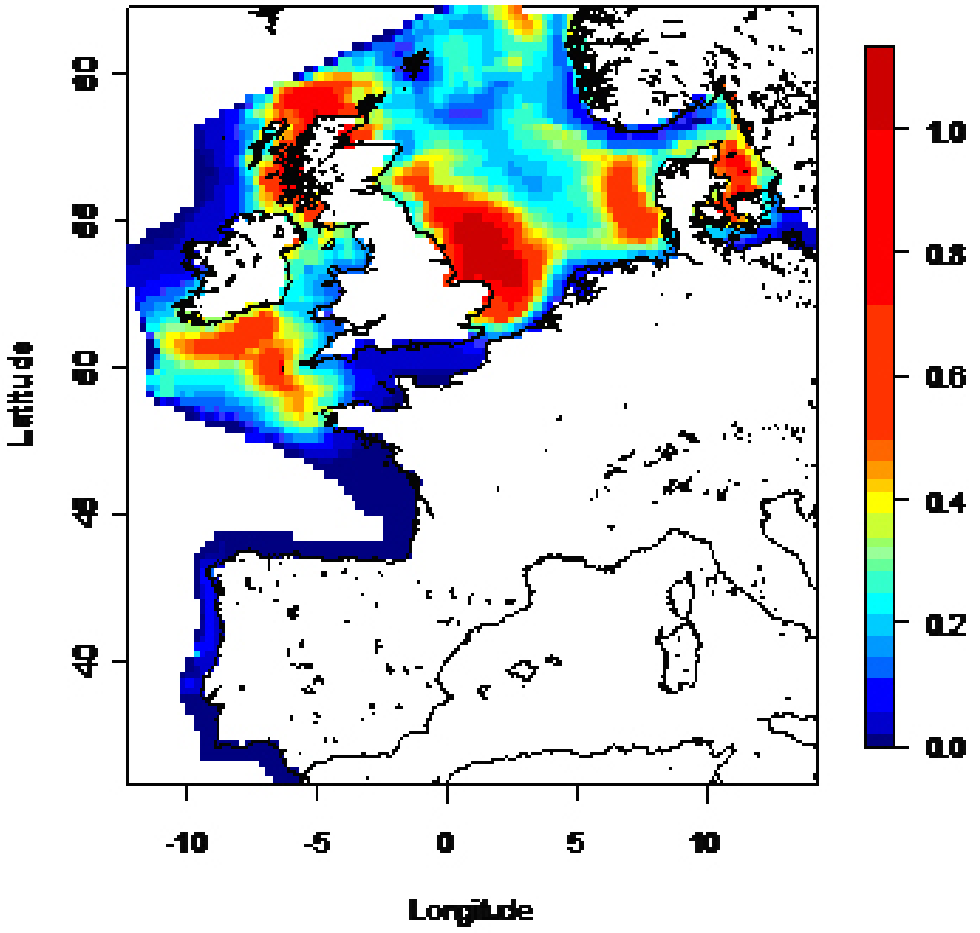
Variation in source, transmission, receptor

Very selective of parts of marine system



1994

2005

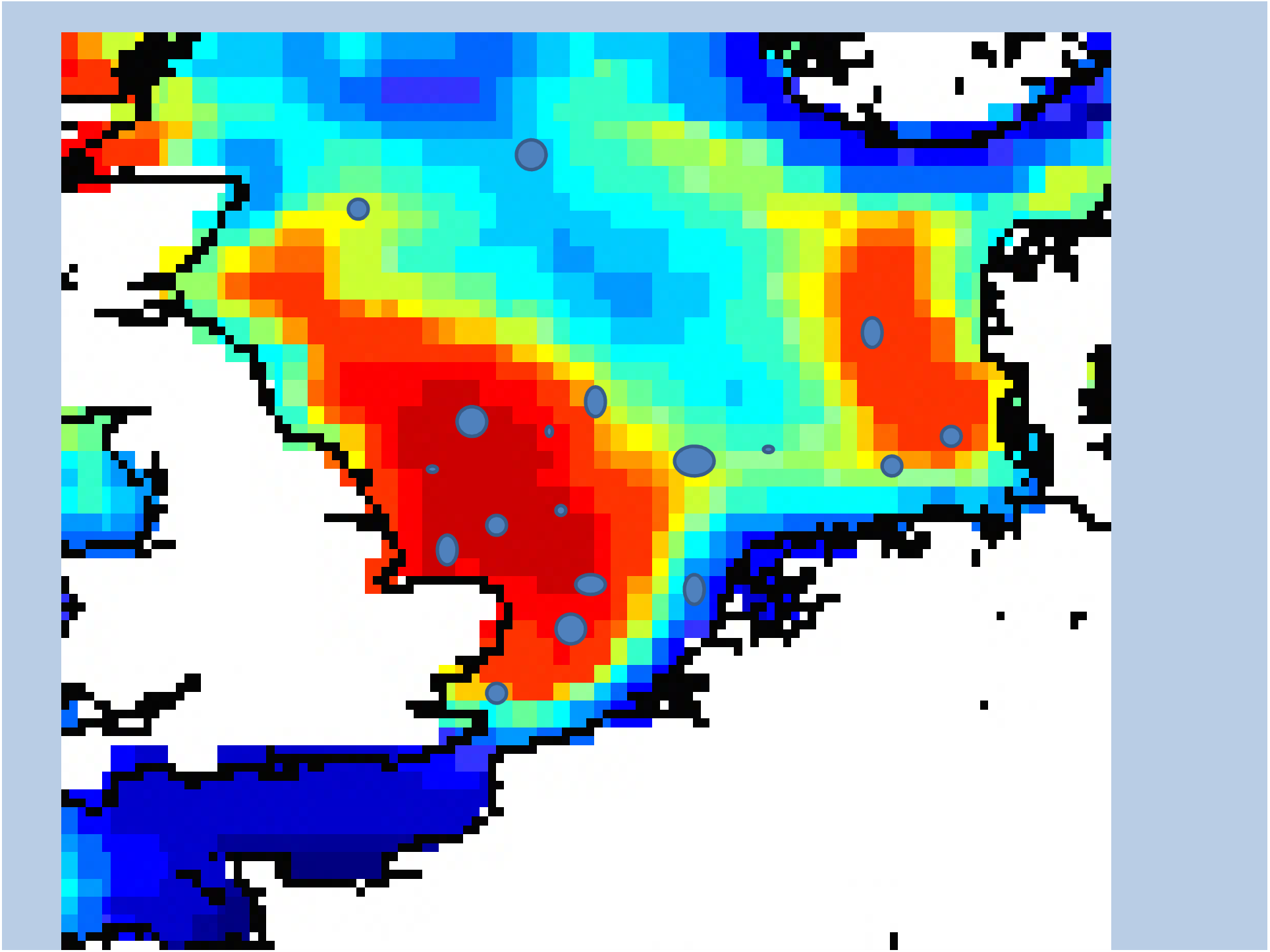


Occurrence of animals not predictable, therefore vulnerability not predictable by area

Two main “adverse effects” addressed

Gaps in distribution caused by behavioural alterations after “loud” impulsive sounds

Communication difficulties caused by low frequency noise



Commission decision:

Proportion of days and their distribution within a calendar year over areas of a determined surface, as well as their spatial distribution, in which anthropogenic sound sources exceed levels that are likely to entail significant impact on marine animals measured as sound exposure level (in dB re $1\mu Pa^{2}\cdot s$) or as peak sound pressure level (in dB re $1\mu Pa_{peak}$) at one metre, measured over the frequency band 10 Hz to 10 kHz.

The proportion of days within a calendar year, over areas of 15’N x 15’E/W in which anthropogenic sound sources exceed

One (pulse) day likely to represent a series of pulses, “recovery time” also in order of days, not hours

Area of effect for one species in order of 10s of km

either of two levels, 183 dB re $1\mu Pa^2.s$ (i.e. measured as Sound Exposure Level, SEL) or 224 dB re $1\mu Pa_{peak}$ (i.e. measured as peak sound pressure level) when extrapolated to one metre,

Why these source level recommendations?

based on received levels for temporary threshold shift in small cetaceans in most comprehensive review of evidence available

A better technical description might be to limit received levels at 1m to these figures

Cannot guarantee no receiver near to source and adds precaution – e.g. for other receivers

SEL and/or peak?

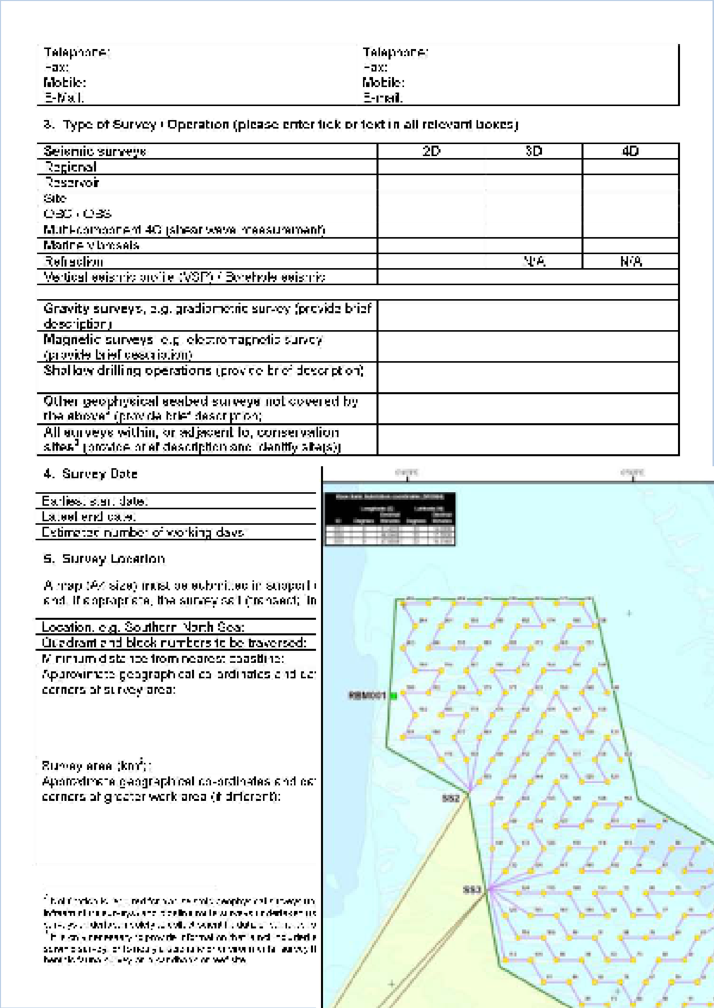
Evidence that SEL matters more than peak in "damage", not known for behaviour

measured over the frequency band
10 Hz to 10 kHz

High amplitude, low and mid frequency sounds – usually licensed or under EIA

Noise Register:

Areas of 10 min lat and 12 min long chosen as these are UK licensing blocks for hydrocarbons; some information already exists on the basis of these (mostly seismic survey) – relatively easy to add other information. There are 3541 blocks or part blocks in UK marine waters.



Telephone:	Telephone:
Fax:	Fax:
Mobile:	Mobile:
E-Mail:	E-mail:

3. Type of Survey / Operation (please enter tick or text in all relevant boxes)

Seismic surveys	2D	3D	4D
Regional			
Reservoir			
Site			
OBC / OBS			
Multi-component 4C (shear wave measurement)			
Marine vibroseis			
Refraction		N/A	N/A
Vertical seismic profile (VSP) / Borehole seismic			

Gravity surveys, e.g. gradiometric survey (provide brief description)	
Magnetic surveys, e.g. electromagnetic survey (provide brief description)	
Shallow drilling operations (provide brief description)	
Other geophysical seabed surveys not covered by the above (provide brief description)	
All surveys within, or adjacent to, conservation sites (provide brief description and identify site(s))	

4. Survey Date

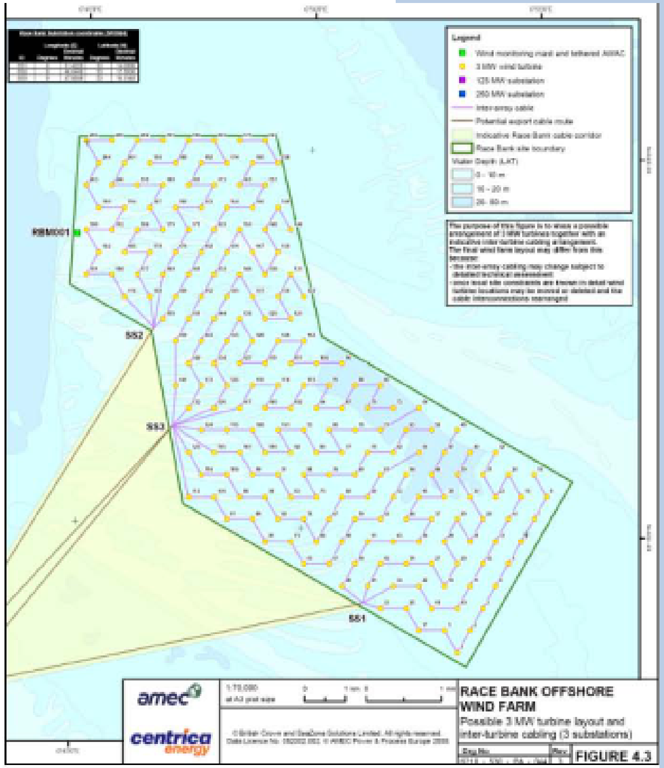
Earliest start date:
Latest end date:
Estimated number of working days:

5. Survey Location

A map (A4 size) must be submitted in support
and, if appropriate, the survey

Location, e.g. Southern North Sea:
Quadrant and block numbers to be traversed:
Minimum distance from nearest coastline:
Approximate geographical co-ordinates and co
corners of survey area:

Survey area (km²):
Approximate geographical co-ordinates and co
corners of greater work area (if different):



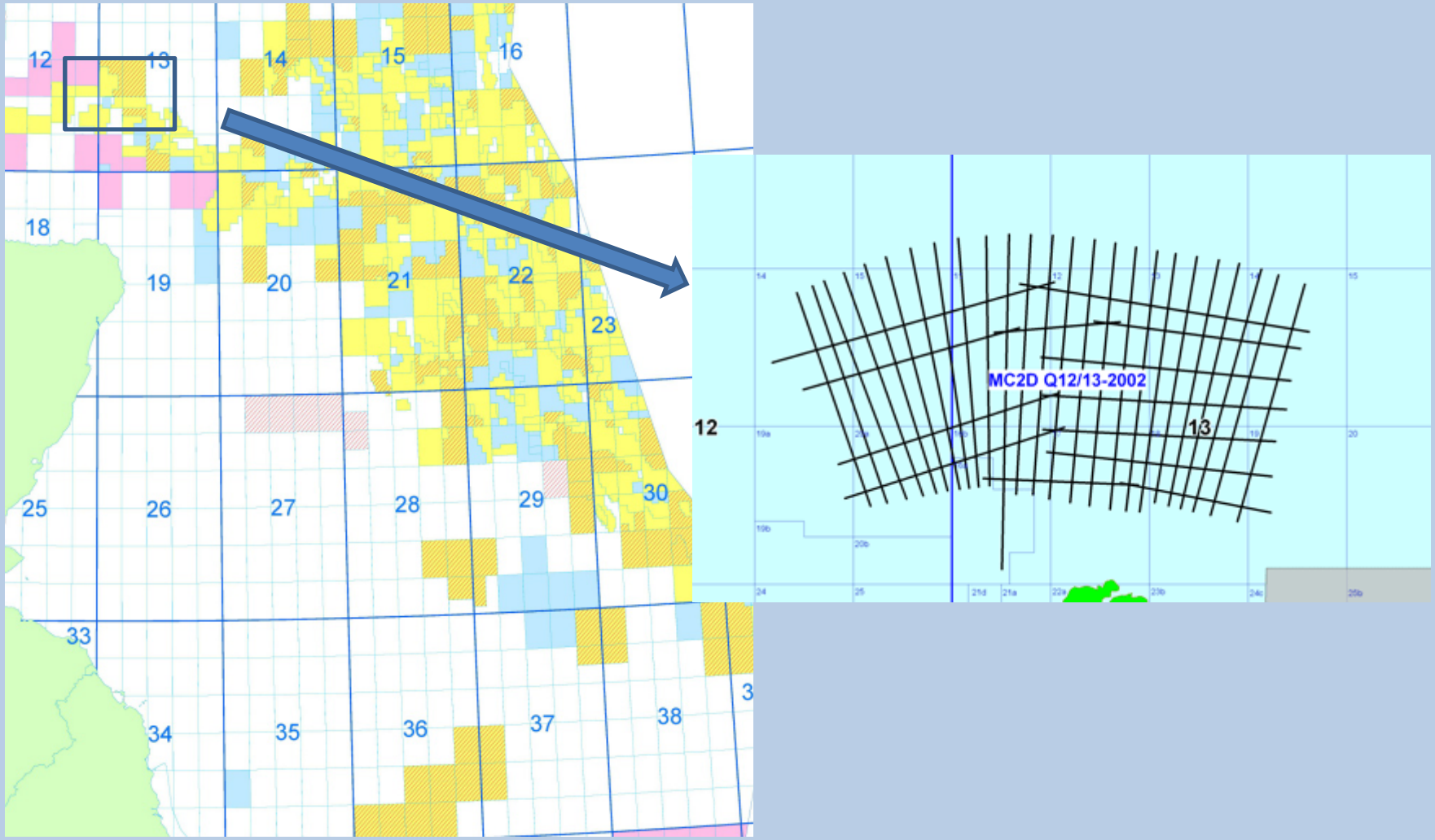
igure 3.1 Site location and indicative turbine layout using three substations (Source: Figure 4.3 in Centrica 2009[8])

UK PON14 for registering seismic surveys

Map in wind farm Environmental Impact Assessment

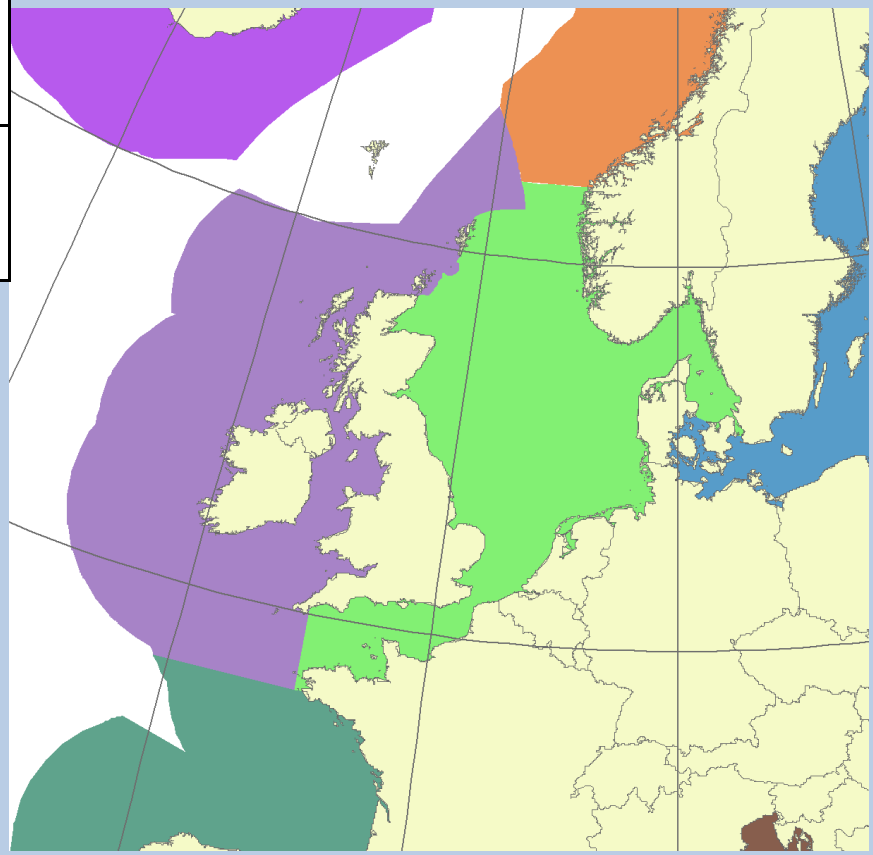
?

Other activities, e.g. explosives use, pile driving on coasts etc



Each block scored for a pulse day

	MSFD Regional Sea	
	North Sea	Celtic Seas
Total seismic pulse-block-days in 2010	8502	7453
Number of UK blocks in MSFD Regional Sea	1324	2216
Average pulse days per year per block	6.4	3.4



Geographic variation in seismic pulse days by UK part of MSFD Regional Seas (2010 may not be typical)

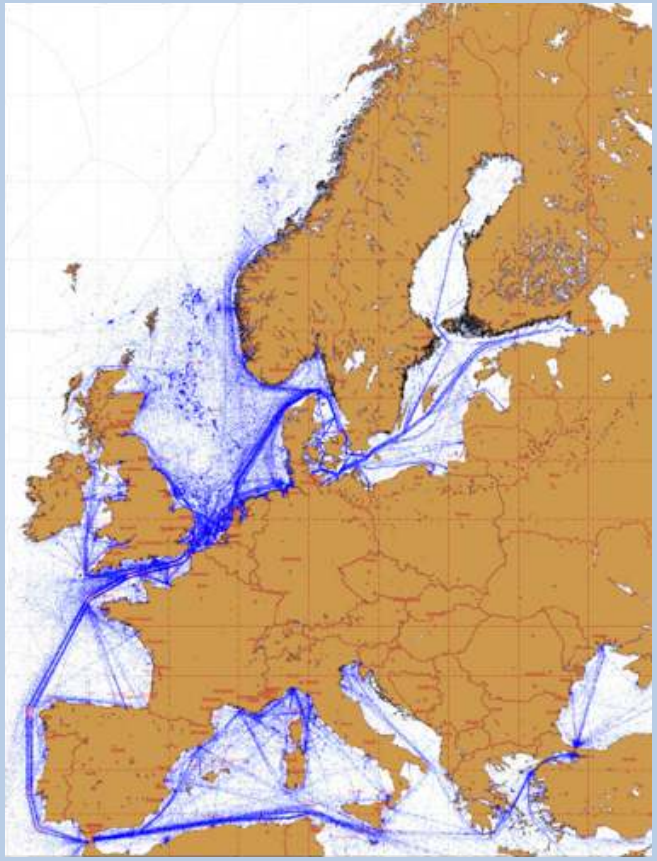
Implications for implementation

Needs a pre-licensing noise register for regulators to check against. Maybe easiest if some temporally-based targets set.

The thresholds are merely a tool to register loud low frequency activities in the licensing blocks; no measurements are necessary, need to know which noises to register in advance.

A larger management scale that was not possible previously in single EIAs; single EIAs only look at injury and not behavioural disruption.

Communication difficulties caused by low frequency noise



shipping route map derived from the analysis of Advanced Synthetic Aperture Radar (ASAR) instrument on ESA's Envisat satellite between 2002 to 2009. The map shows yearly average tropospheric nitrogen dioxide measurements for 2008. OMI represents the Dutch contribution to the mission.
Credits: CLS – KNMI – ESA

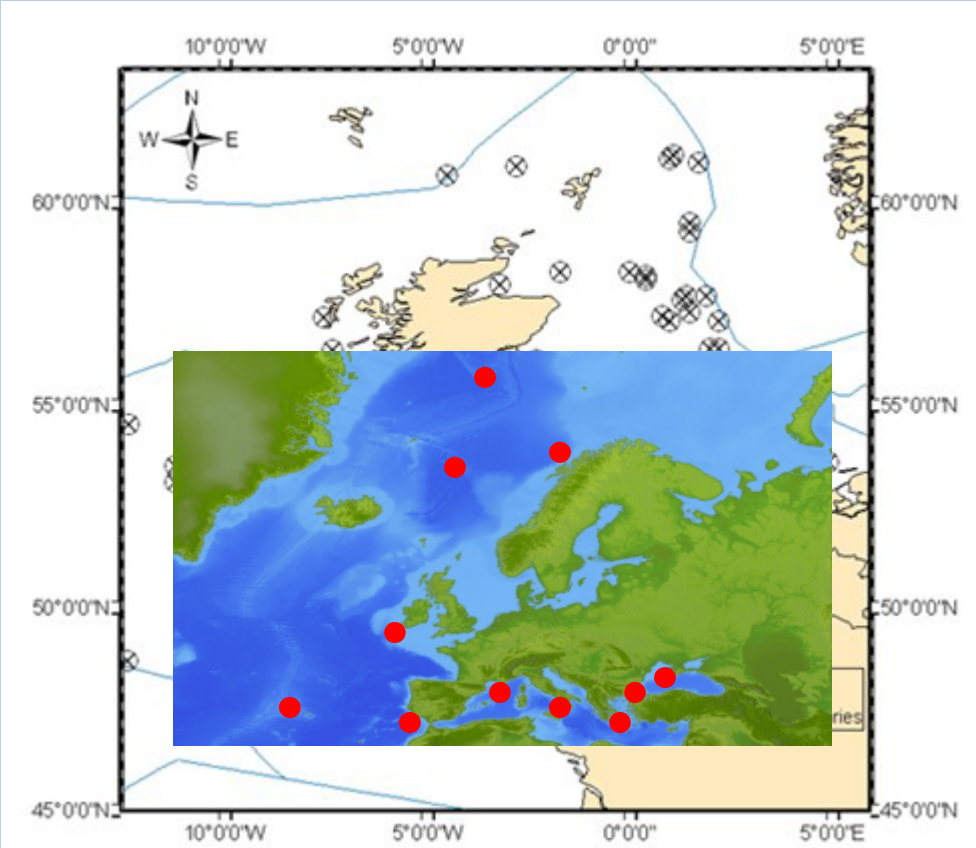
Trends in the ambient noise level within the 1/3 octave bands 63 and 125 Hz (centre frequency) (re 1µPa rms; average noise level in these octave bands over a year) measured by observation stations and/or with the use of models if appropriate

Trends in the ambient noise level within the 1/3 octave bands 63 and 125 Hz (centre frequency) (re 1µPa rms; average noise level in these octave bands over a year)

These 1/3 octave bands are characteristic of shipping noise, and exceed “natural” ambient

measured by observation stations and/or with the use of models if appropriate

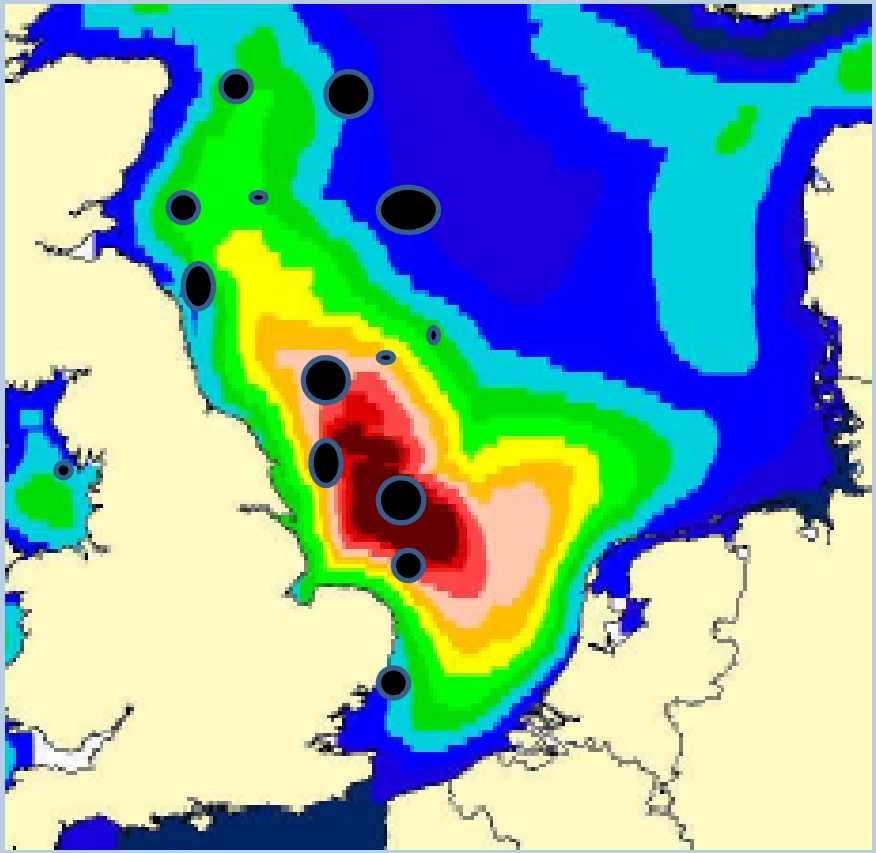
Develop network of observation stations and relevant models



At what stage does “loss of habitat” become significant?

Avoiding gaps in distribution

Need to model effects of temporary loss of habitat



How to manage?

Multiple regulators in one country

Multiple countries

Shipping is international

How do other industries share out common goods?

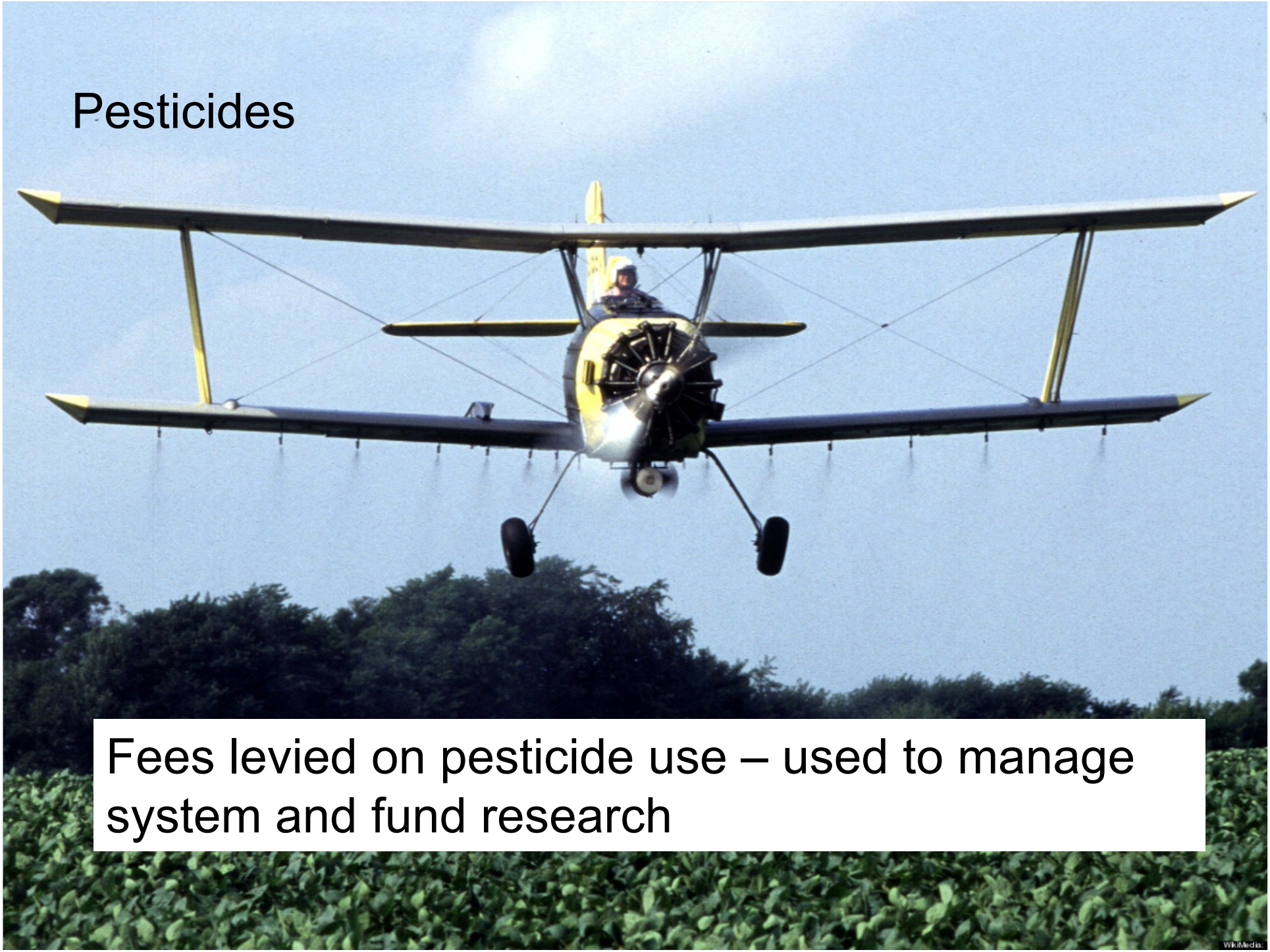
Fisheries

Complex quota management that depends on many agreed rules (and which costs a great deal)

Carbon emissions

Regional (e.g. EU) carbon markets where those emitting carbon buy and trade credits

Pesticides



Fees levied on pesticide use – used to manage system and fund research

Offsetting

Harbour porpoise bycatch in gillnets

Several thousand likely killed in fisheries per year

For MSFD we need a management framework

1. Establish international noise register

2. International agreement on thresholds for concern

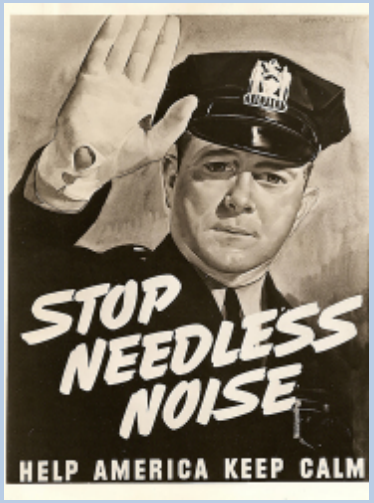
3. Model to determine if risk from disturbance infringes thresholds

4. Agree mechanism to share “noise allowance” internationally

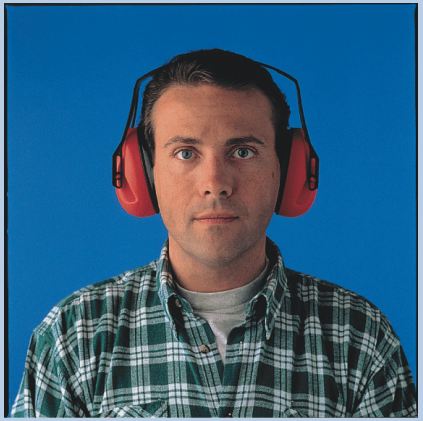
5. Agree mechanisms to restrict amount of noise emitted

NOT Simple!

Avoid noise – chose a different technology



Reduce noise – use one of the noise reduction technologies



Mitigate effect – e.g. turn off noise if animal arrives

Perhaps easiest to avoid noise emissions!