

Monitoring Cetaceans



What is a Cetacean?

- Collective term for whales, dolphins and porpoises
- *Cetus* and *ketos*
- 88 species (Perrin, Wursig and Thewissen 2002)
- Smallest – Hector's Dolphin *Cephalorhynchus hectori*
- Largest – Blue Whale *Balaenoptera musculus*



Cetaceans



- Oceanic and riverine habitats (Boto, Irawaddy dolphin, Tucuxi, Ganges and Indus River Dolphins, finless porpoise)
- Diet varies
- Reproduction – live young
- **The various traits and behaviour allow for the development of monitoring techniques**

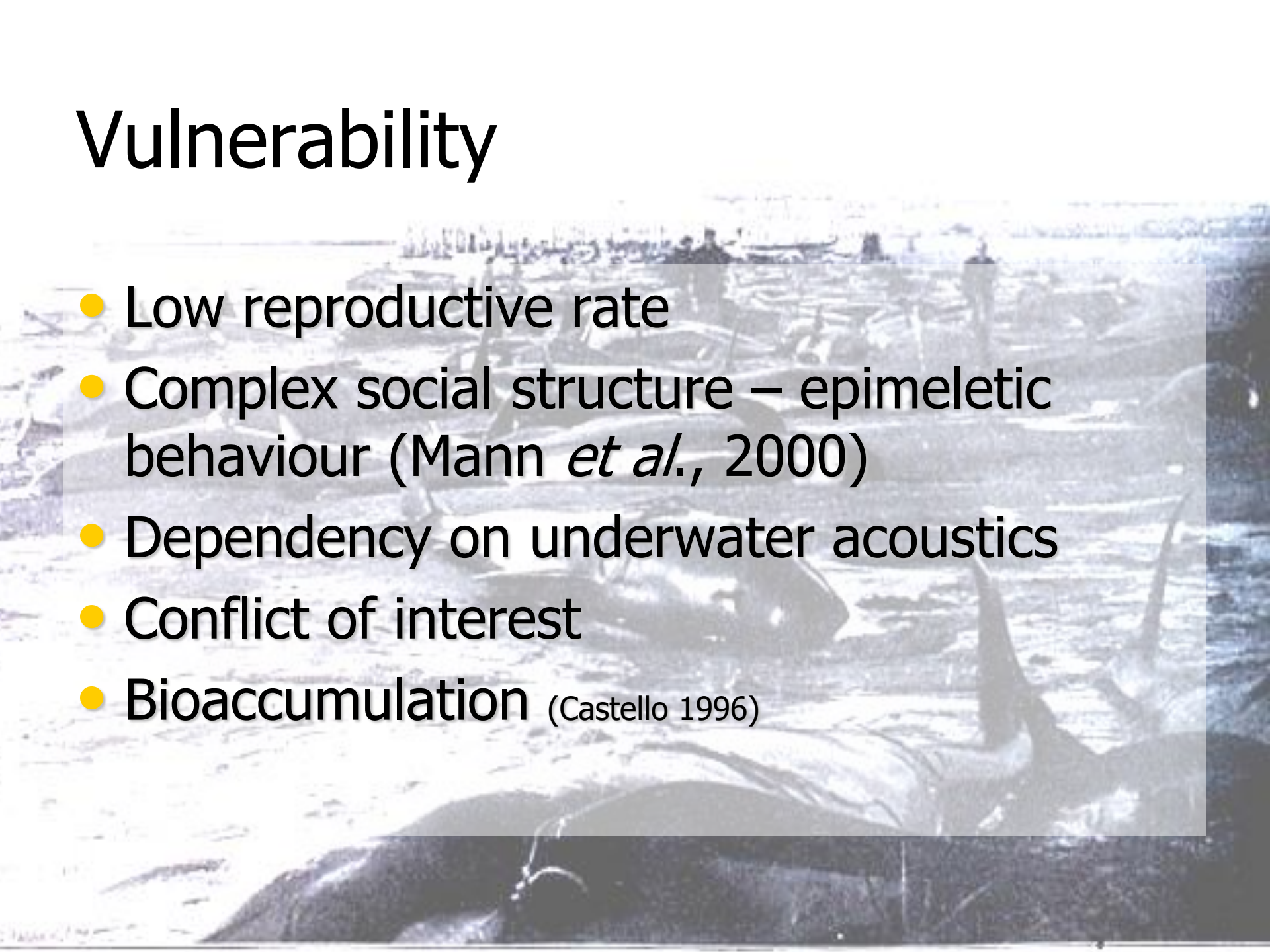
Threats

- Direct exploitation
- Incidental capture
- Culling operations
- Pollution
- Habitat loss
- Climate Change (IUCN
The World Conservation Union 1996)



Vulnerability

- Low reproductive rate
- Complex social structure – epimeletic behaviour (Mann *et al.*, 2000)
- Dependency on underwater acoustics
- Conflict of interest
- Bioaccumulation (Castello 1996)







Fin Whale *Balaenoptera physalus*



Why Monitor them?

- Biodiversity
- Bio indicators
- Economic benefit
- Population status
 - Development & EIA
 - Conservation areas



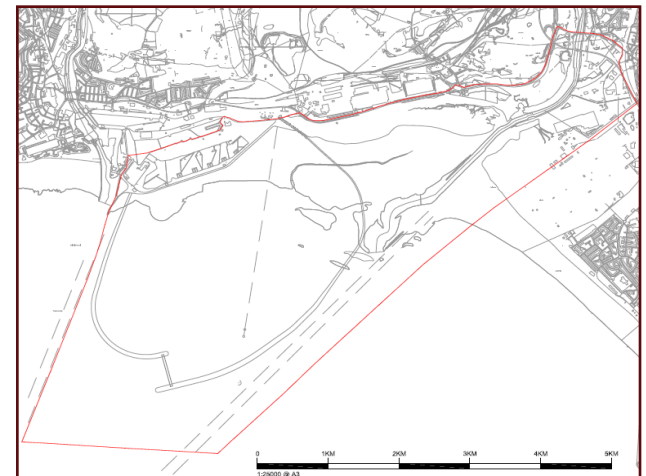


Artist's Impression

Environmental Impact Assessment

Areas under study:

- Coastal Processes, Sediment Transport and Contamination
- Marine Water Quality, Water Framework Directive
- Intertidal and Sub-tidal Benthic Ecology
- Fish
- Recreational and Commercial Fisheries
- **Marine Mammals**
- Coastal Birds
- Habitat Regulation Assessment
- Navigation and Marine Transport Assessment
- Terrestrial Ecology
- Seascape and Visual Amenity Impact Assessment
- Onshore Transport Assessment and Air Quality
- Economy, Tourism and Recreation
- Marine and Terrestrial Noise Assessment
- Marine and Terrestrial Archaeology and Historic Landscape



Study process

A comprehensive assessment of impacts using baseline surveys and modelling, from construction to decommissioning, and including cumulative impacts from other proposed development and activities.

Scoping report submission to the Planning Inspectorate: **15 October 2012**

Overview of Key Issues to be assessed in EIA	Environmental Interaction
Disturbance of contaminated sediments during construction leading to changes in water quality through raised sediment loads and dispersal of contaminants (e.g. heavy metals)	Water quality, marine mammals, marine ecology, fisheries, and hence ornithology, recreational use
Changes in the wave climate and tidal circulations which may impede safe navigation into Swansea docks/marina, River Neath	Marine transport and Navigation Risk Assessment
Change in wave climate and the potential effect on recreation use of local beaches	Tourism and recreation
Changes in local flows in the vicinity of turbines and the risk of scouring the local seabed to release contaminated sediments and hence knock on effect on water quality	Effects on marine mammals, marine ecology, fisheries, and hence ornithology
Changes in siltation outside of lagoon which might increase dredging requirements in the approach channel to Swansea docks, the River Neath and upstream marinas, etc	Marine transport and Navigation Risk Assessment (NRA)
Assessment of sediment accumulation/flow patterns within the lagoon during operation and need for maintenance dredging. Opportunities for certain shellfish spp inside the lagoon.	Marine transport and Navigation Risk Assessment (NRA). Fisheries.

Has the Scoping Report adequately addressed these concerns?

5. Marine Mammals

Challenge	Concern	Action
Collision Risk	Higher bycatch rates for HP	Investigate appropriate catch and release procedure
Inadequate baseline data	Data selected from old reports (GMMP, 2004) or from sites offshore (Atlantic Array); short-term surveys	Seek up-to-date data from local 'experts'
Inadequate baseline data	Annual grey seal monitoring by Wildlife Trust of South & West Wales omitted	Seek up-to-date data from local 'experts'
Over-optimistic conclusions	"some potential for limited loss in foraging ground for HP" -	Carry out dedicated HP behavioural surveys - not done by any of the aforementioned reports
Identification of critical habitats for HP	Strandings data revealing potential nursery site in Swansea Bay overlooked	Consider annual strandings reports as well as group size/behavioural analyses

Harbour Porpoise Strandings Data 1994-2012 for the survey area

Site	No. Harbour Porpoise	Months	State of Carcass						Gender			Age				
			F	S	M	A	U	L	M	F	U	N	C	J	A	U
Port Talbot: (Aberavon, Corus, Briton Ferry)	32	April, May, June, July, August, September, October, November, December	2	1	7	13	5	4	4	11	18	3	3	4	10	13
Swansea Bay: (Crymlyn, Jersey Marine, The Slip, Black Pill)	17	January, February, March, June, July, September, October	6	3	5	4	1		4	10	5	4	1	4	5	5
Mumbles: (Rotherslade, Caswell, Langland)	10	April, May, June, July, August, September, October, December	2	1	3	4		1	3	2	6	1	3	1	2	4

Key:

State of carcass: Fresh (**F**); Slight decomposition (**S**); Moderate decomposition (**M**); Advanced decomposition (**A**); Unknown status (**U**); (**L**) Live

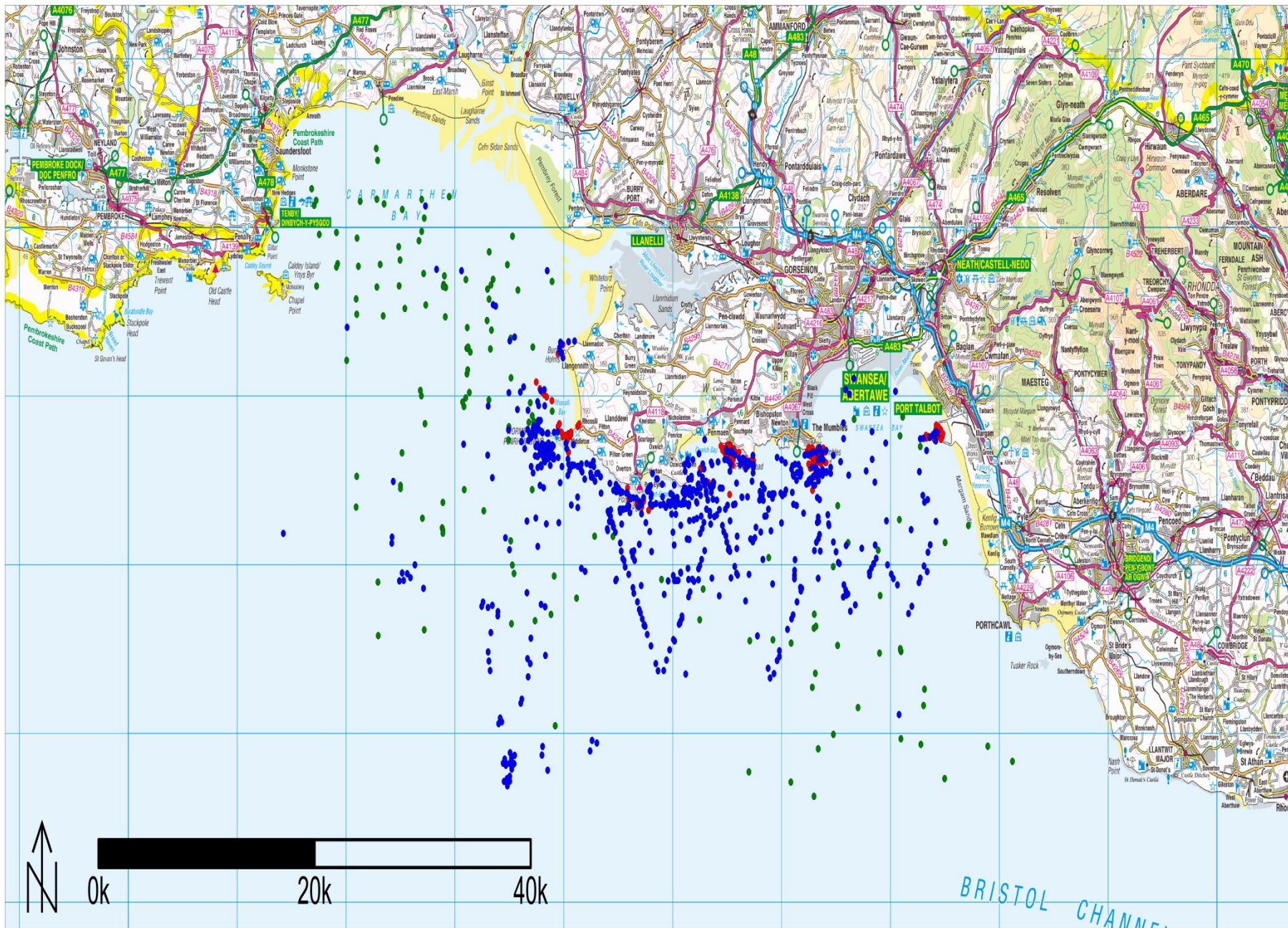
Gender: Male (**M**); Female (**F**); Unknown (**U**)

Age: Neonate <90cm (**N**); Calf 91-110cm (**C**); Juvenile 111-129cm (**J**); Adult >130cm (**A**); Unknown (**U**)



Proximity to Swansea
Bay & Port Talbot Docks





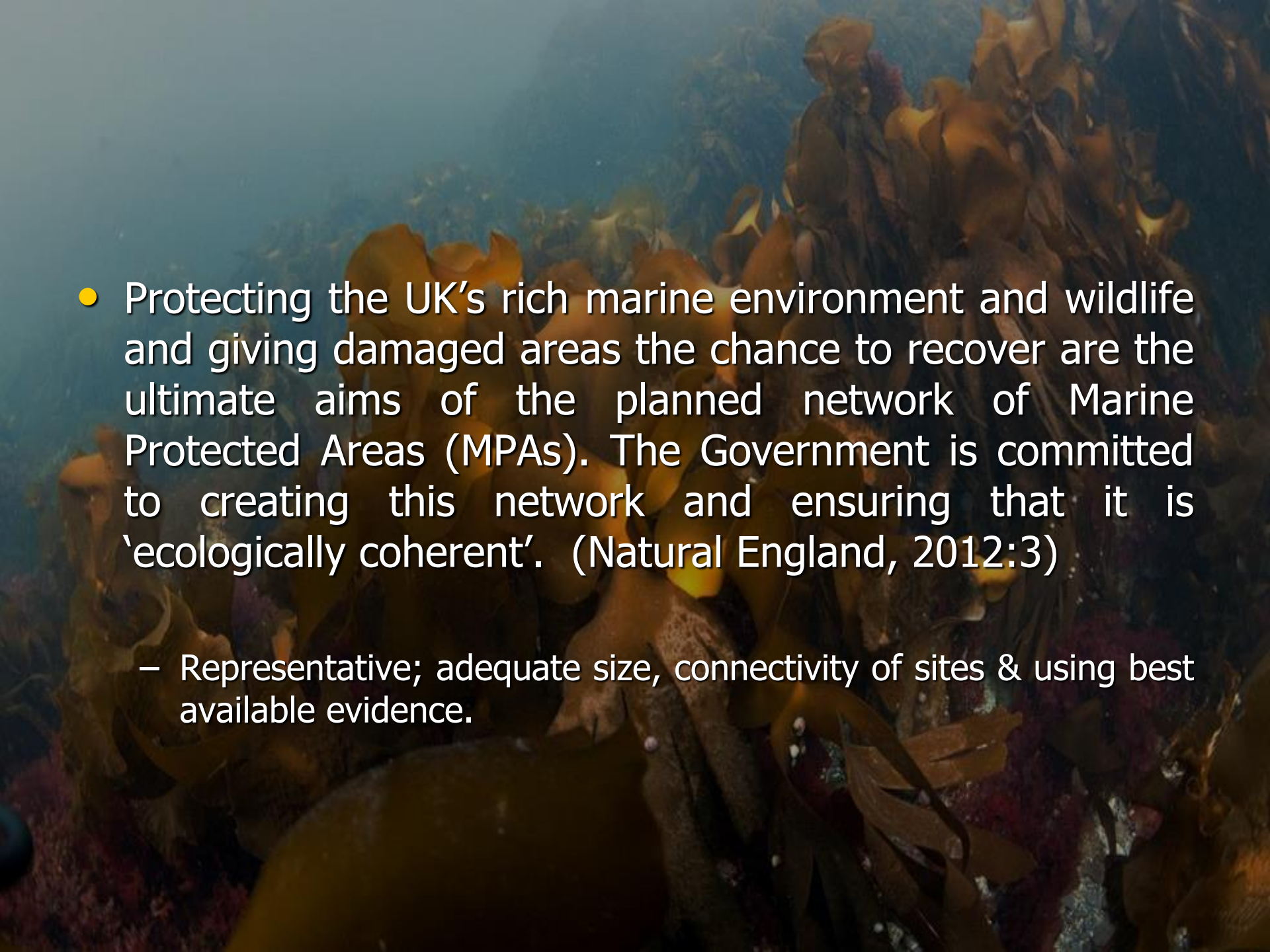
Why Monitor them?

- Biodiversity
- Bio indicators
- Economic benefit
- Population status:
 - Development & EIA
 - **Conservation Areas**





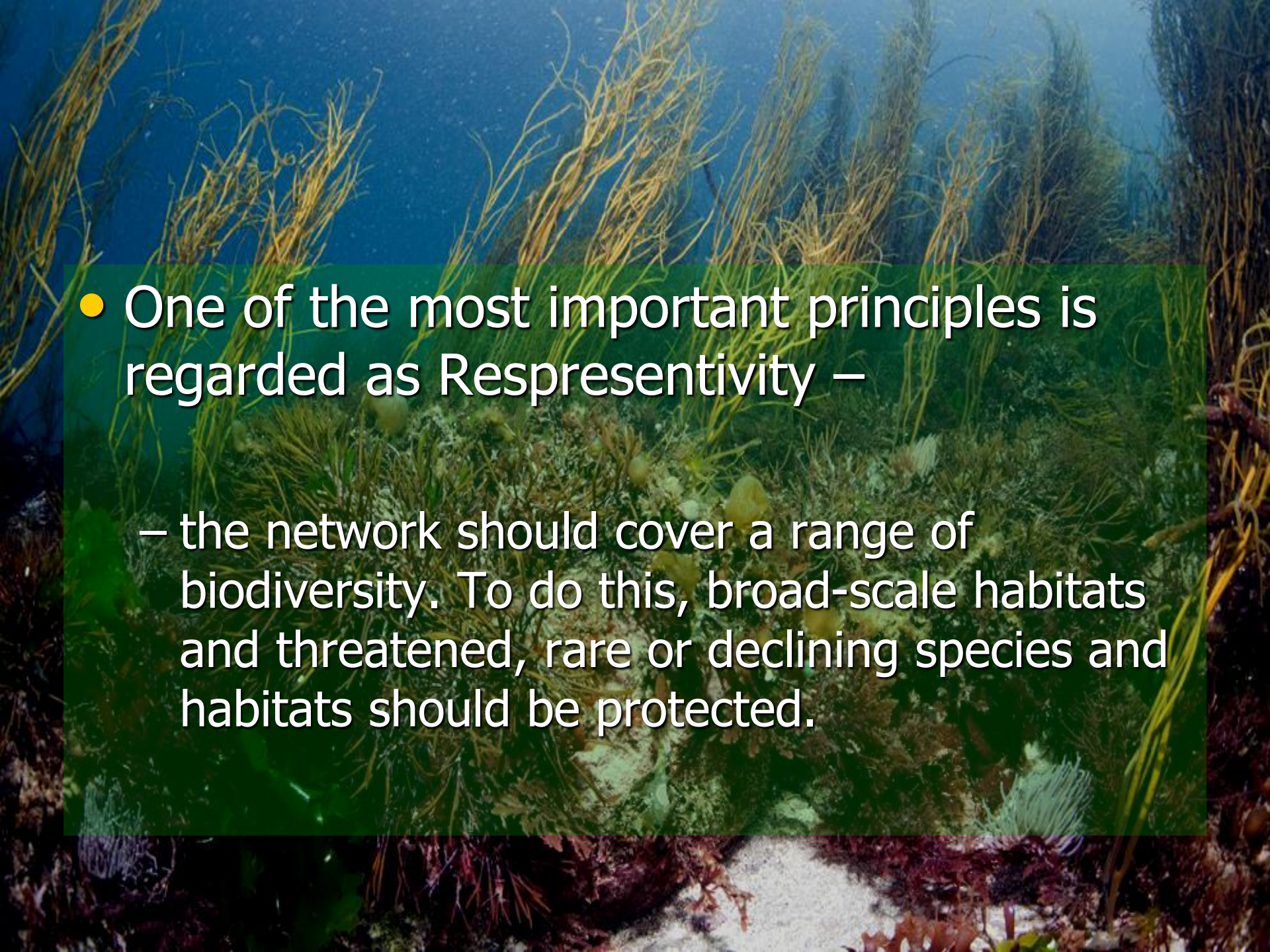
- **The Marine and Coastal Access Act 2009 enables the designation and protection of Marine Conservation Zones (MCZs). These are a type of marine protected area, which will exist alongside European marine sites (Special Areas of Conservation (SACs) and Special Protected Areas (SPAs)), SSSIs and Ramsar sites to form an ecologically coherent network of marine protected areas.**

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- An underwater photograph showing a dense field of brown seaweed or kelp. The seaweed has large, wavy, leaf-like blades and thick, woody stipes. The water is a clear, slightly blue-green color, and the lighting is soft, creating a serene underwater environment.
- Protecting the UK's rich marine environment and wildlife and giving damaged areas the chance to recover are the ultimate aims of the planned network of Marine Protected Areas (MPAs). The Government is committed to creating this network and ensuring that it is 'ecologically coherent'. (Natural England, 2012:3)
 - Representative; adequate size, connectivity of sites & using best available evidence.

- 
- An underwater photograph of a coral reef. The water is a deep blue. In the foreground and middle ground, there are various types of coral, including branching corals and some with yellowish tips. Several small, light-colored fish are visible swimming among the coral. The overall scene is a healthy marine ecosystem.
- An important aim of MPA networks is to promote resilience of marine ecosystems. Resilient ecosystems can absorb, resist or recover from disturbances and damage caused by natural change and human activities.

“Diversity is common to all parts of the concept of ecological resilience Retaining biodiversity of all forms in ecosystems is important to retain resilience. This should include the structure of biodiversity at the ecosystem level (species types, distributions and abundance), and genetic diversity at the population level (gene diversity, subpopulation differences). Diverse structural biodiversity and genetic diversity help organisms to respond to environmental pressures” (Australian Gov’t, 2011:1)



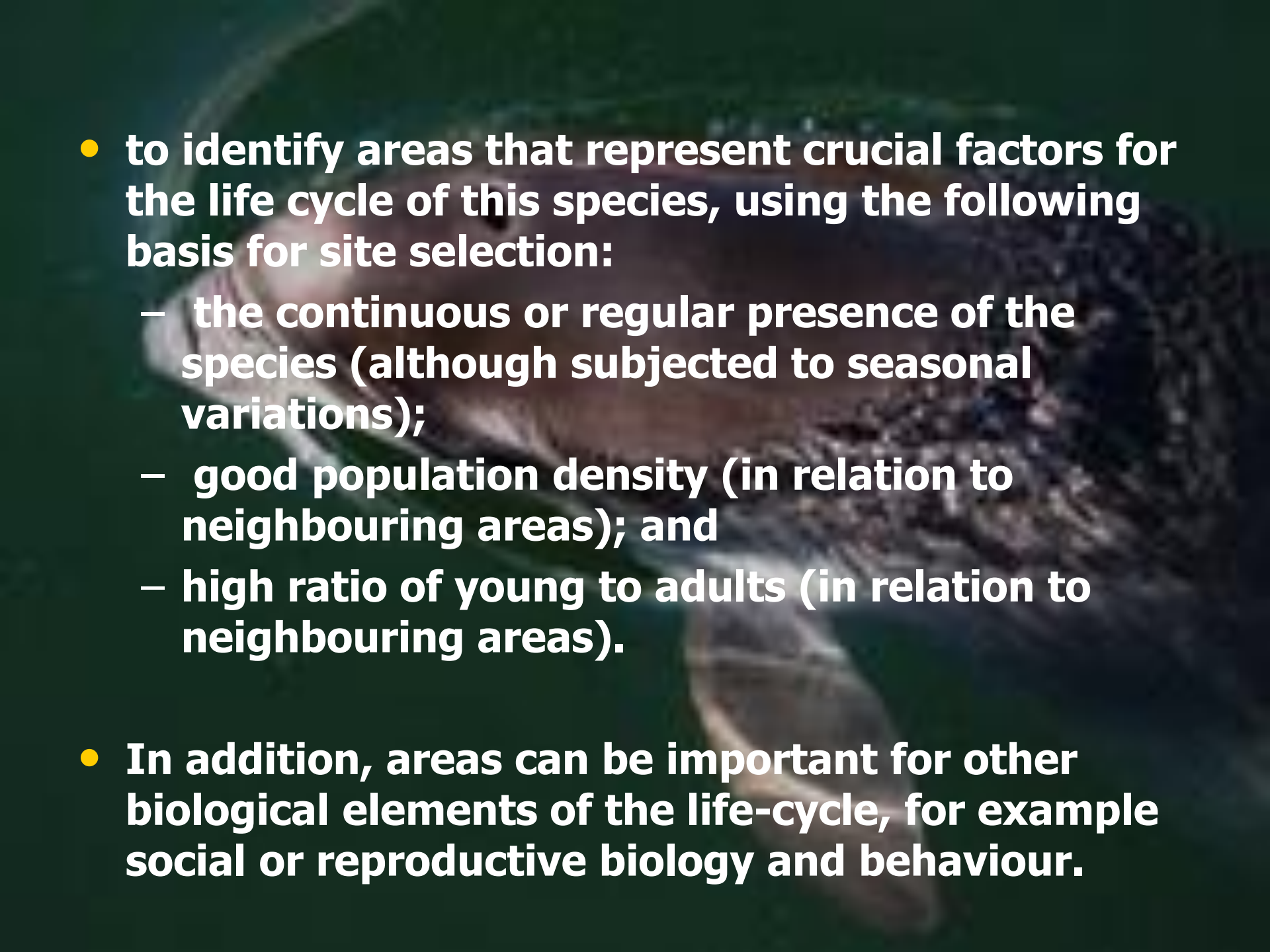
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- An underwater photograph showing a vibrant marine ecosystem. In the foreground, there's a sandy bottom with patches of red and purple coral or anemones. Above them, a dense field of green seagrass or similar plants grows. In the background, tall, thin, yellowish-brown structures, possibly giant kelp or similar, rise towards the surface. The water is clear and blue.
- One of the most important principles is regarded as Representativity –
 - the network should cover a range of biodiversity. To do this, broad-scale habitats and threatened, rare or declining species and habitats should be protected.

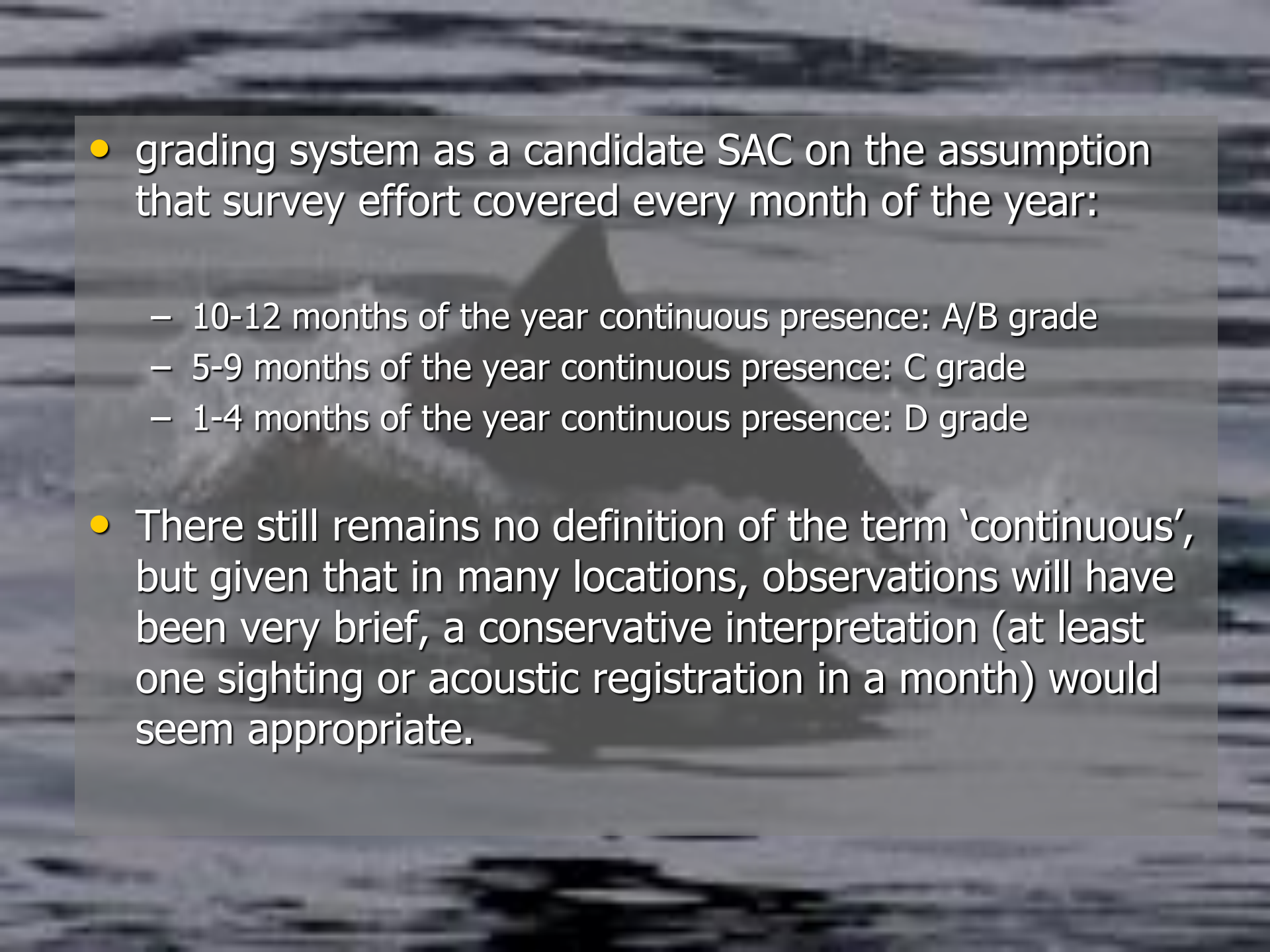


- Under the Habitats Directive 92/43/EEC all cetacean species are listed for protection, and member states are obliged to **identify and designate SACs** for both the BND and harbour porpoise. It is widely recognised that UK seas form an important stronghold for harbour porpoise in north-western Europe, and although site protection measures are more complicated to apply to mobile species, there is good evidence of particular sites being used persistently by this species in UK seas
- UK has yet to submit any sites for the harbour porpoise

Just an aside.....

- European Commission announced infringement action against the UK Government for failing to identify sites to protect harbour porpoise
- Sites include the Outer Bristol Channel for example
- Case of the Atlantic Array – “harbour porpoise, common dolphin and grey seals are present all year round” (Environmental Statement from RWE, 2013)
- ...” building of offshore wind farms have the potential to harm these species but they found the effects to be of minor adverse significance” based on what evidence/method (Youle, 2013) – Evening Post, 27th August, 20-21
- Government has had 20 years to protect harbour porpoise under the Habitats Directive by designation Special Areas of Conservation
- According to Defra, the Government want wind farms and want to abide by EU legislation..... irony?

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- **to identify areas that represent crucial factors for the life cycle of this species, using the following basis for site selection:**
 - **the continuous or regular presence of the species (although subjected to seasonal variations);**
 - **good population density (in relation to neighbouring areas); and**
 - **high ratio of young to adults (in relation to neighbouring areas).**
 - **In addition, areas can be important for other biological elements of the life-cycle, for example social or reproductive biology and behaviour.**

- 
- grading system as a candidate SAC on the assumption that survey effort covered every month of the year:
 - 10-12 months of the year continuous presence: A/B grade
 - 5-9 months of the year continuous presence: C grade
 - 1-4 months of the year continuous presence: D grade
 - There still remains no definition of the term 'continuous', but given that in many locations, observations will have been very brief, a conservative interpretation (at least one sighting or acoustic registration in a month) would seem appropriate.

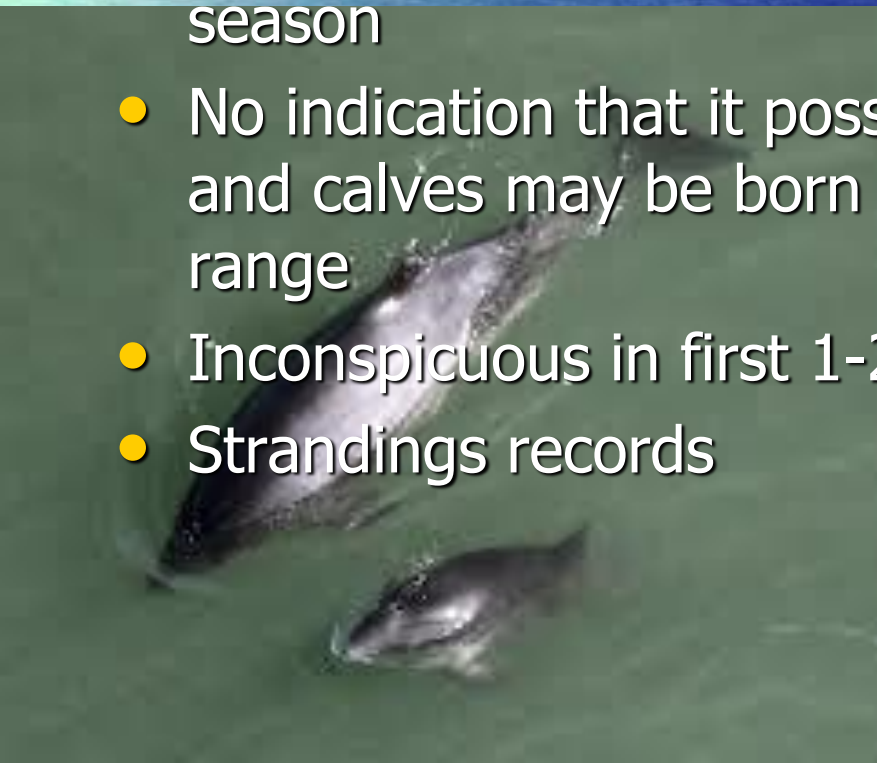
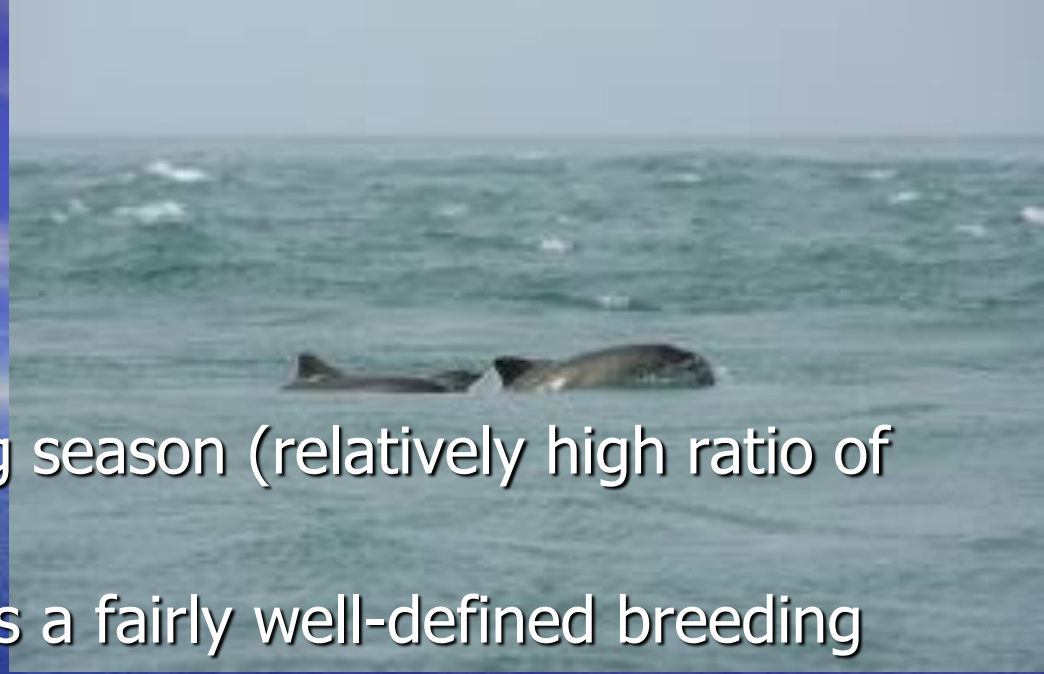
A more appropriate scheme might better reflect the animal's life history:

- **10-12 months of the year continuous presence: A grade**
- **7-9 months of the year continuous presence: B grade**
- **4-6 months of the year continuous presence: C grade**
- **1-3 months of the year continuous presence: D grade**

More relevant from a conservation perspective is whether the site remains in use by porpoises over a period of years. For most countries, such assessment has been based on surveys for a period of 1-5 years and no more.

- **Good population density** in relation to neighbouring area – mapping and density metrics e.g. numbers per sq km; numbers per km travelled or per hour of observation
- No European country has systematically achieved this yet
- Denmark – telemetry studies

- Presence in the breeding season (relatively high ratio of young to adults)
- the harbour porpoise has a fairly well-defined breeding season
- No indication that it possesses defined breeding areas, and calves may be born virtually anywhere within its range
- Inconspicuous in first 1-2 mnths
- Strandings records



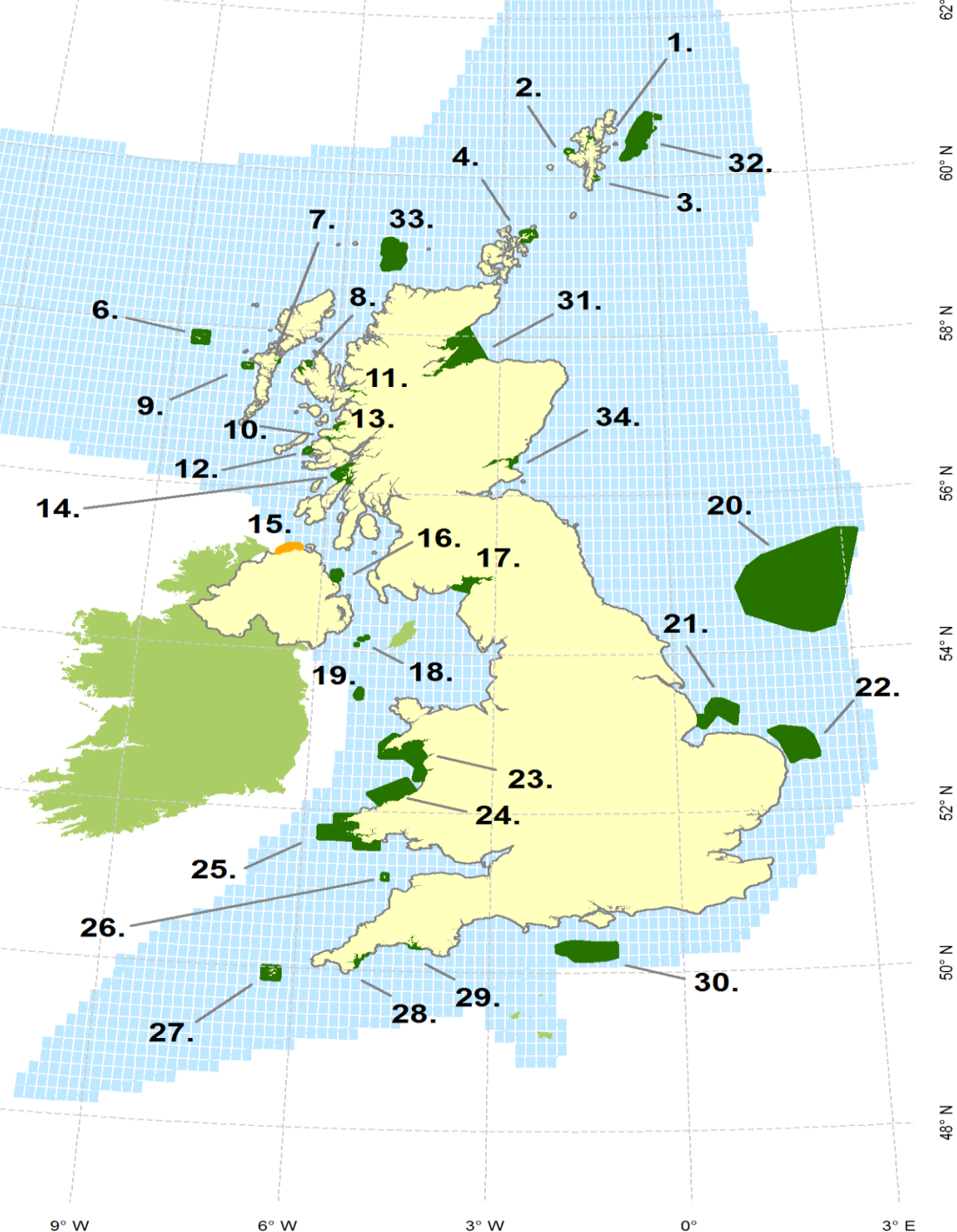
WDCS, 2013

UK SACs (SAC, cSACs and SCLs) with Harbour Porpoise as a feature (Grades C & D)

- Grade C site (Skerries and Causeway only)
- Grade D sites
- UK Exclusive Economic Zone - EEZ (including Isle of Man and Channel Islands Crown Dependencies)
- United Kingdom of Great Britain and Northern Ireland
- Other territories including the Republic of Ireland and the Crown Dependencies of the Isle of Man and the Channel Islands

Site List:

1. Sullom Voe - 2. Papa Stour - 3. Mousa - 4. Sanday - 5. North West Rockall Bank - 6. St. Kilda - 7. Loch nam Madadh - 8. Ascrib, Isay and Dunvegan - 9. Monach Islands - 10. Sunart - 11. Lochs Duich, Long and Aish Reefs - 12. Treshnish - 13. Sound of Arisaig - 14. Firth of Lorn - 15. Skerries and Causeway - 16. The Maidens - 17. Solway Firth - 18. Pisces Reef Complex - 19. Croker Carbonate Slabs - 20. Dogger Bank - 21. Inner Dowsing, Race Bank and North Ridge - 22. Haisborough, Hammond and Winterton - 23. Pen Llyn a'r Sarnau - 24. Cardigan Bay - 25. Pembrokeshire Marine - 26. Lundy - 27. Isles of Scilly Complex - 28. Fal and Helford - 29. Plymouth Sound and Estuary - 30. Wight-Barleur Reef - 31. Moray Firth - 32. Pobie Bank - 33. Solan Bank - 34. Firth of Tay and Eden Estuary

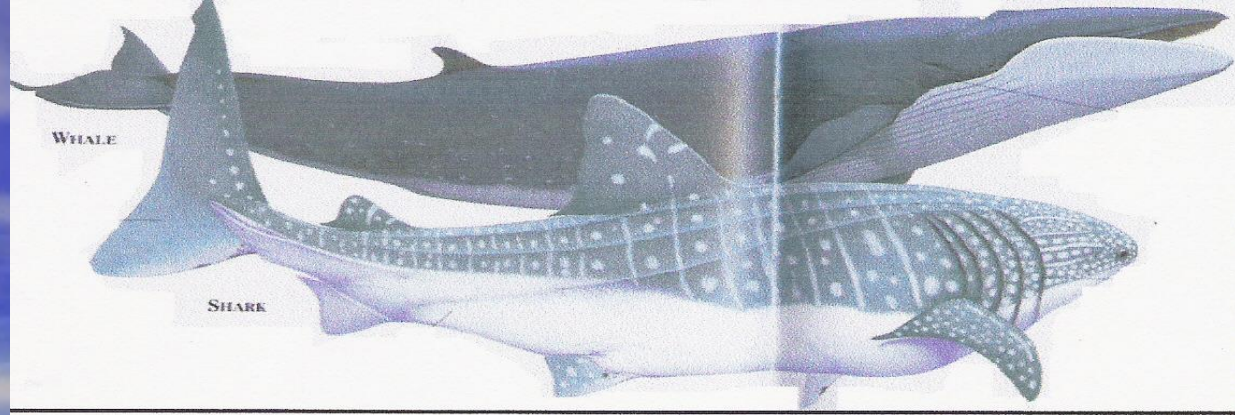


Taken from the Inshore Special Area of Conservation: Skerries and Causeway Management Plan

Harbour porpoise

The monthly effort watch (100 minutes per watch) conducted from Ramore Head showed the presence of harbour porpoise in every month of 2009 and therefore is continuously or regularly present. In addition, calves and juveniles are regularly recorded during effort watches. Although there is continuous presence the population densities are relatively low with harbour porpoise mostly sighted as individuals or very small groups. The Ramore Head site within the SAC boundary contains the highest calf-adult ratio and the second highest young-adult ratio in all of Northern Ireland's coastal waters. The oceanographic features at this site are thought to provide suitable conditions for aggregations of prey species in sufficient quantity and quality to support individual growth, reproduction and development and to allow for movement rest and foraging

Cetacean or Fish?



The various traits and behaviour allow for the development of monitoring techniques

- Tail – distinguishing feature
- Single dorsal fin
- Oxygen extraction



Cetacean Behaviour

- Difficult to determine
- Length of time spent under the water and offshore habitat
- 76% and 89% underwater (Reed *et al.*, 2000)
- Increased effort and technology – unlocking secrets

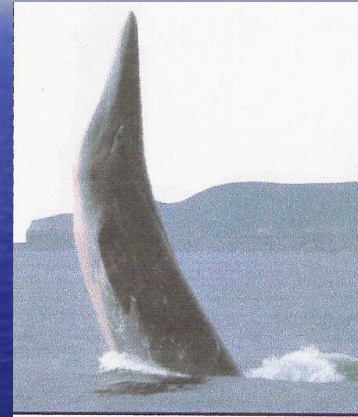


(Oakley, 2011)

Surface Behaviours

1. Breaching

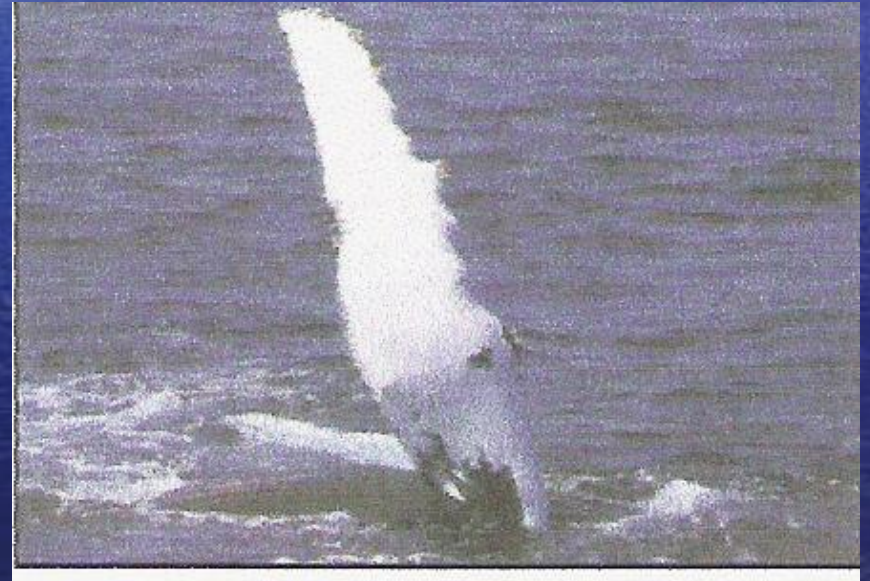
- Launching head-first into the air before falling back into the water
- Somersaults and twists
- Head slaps
- Humpbacks over 200 breaches in one display
- Why? Courtship, herding fish, dislodging parasites, fun!



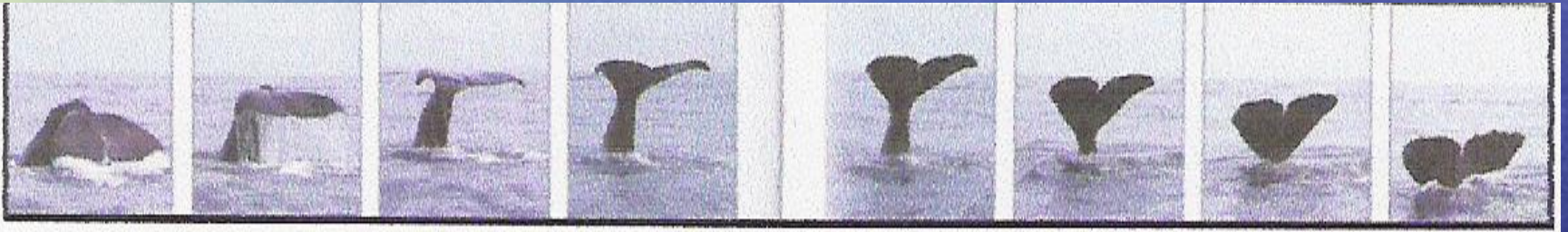
(Jenkins, 1997)

2. Flipper slapping

- When cetaceans roll over at the surface and slap their flippers on the water
- Socialising/fun/attracting mates



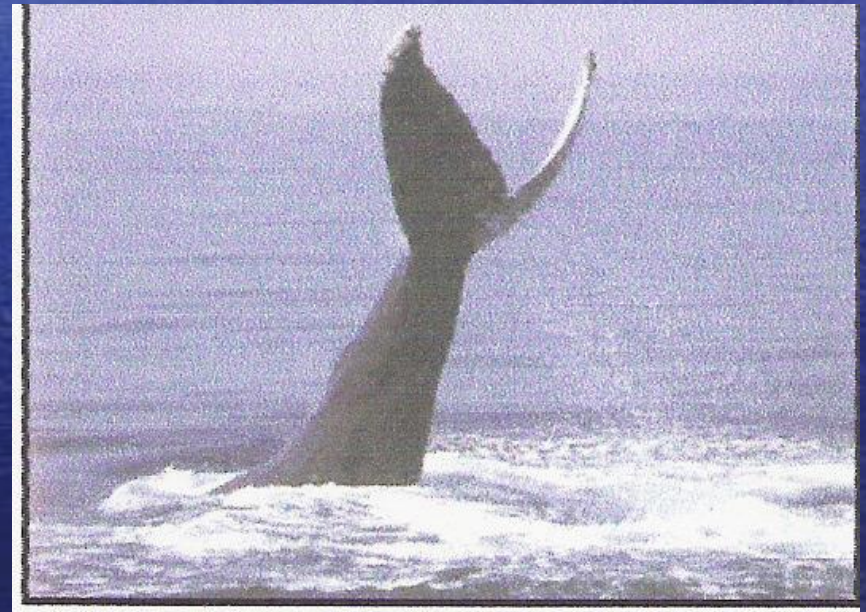
3. Fluking



- Usually prior to a deep dive
- Lifting tail into air helps them into a steeper angled descent
- Tail observations often helps in individual identification

4. Lobtailing

- Forceful slapping of flukes against the water
- Majority of cetacean remains underwater
- Scientists believe it to indicate aggression in some species



5. Spyhopping

- Having a look around!
- The head and eyes protrude just above the surface



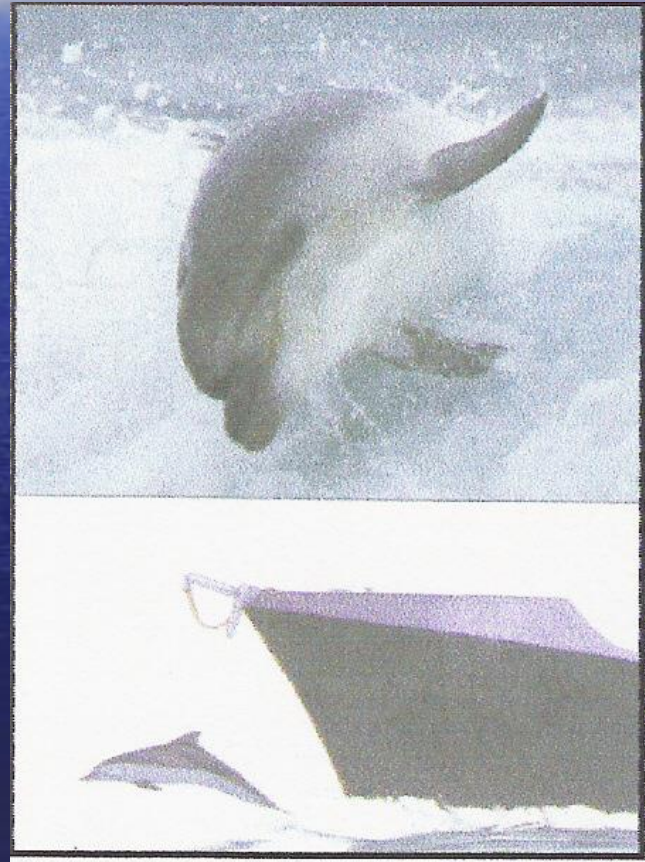
6. Blow

- Exhalation of air followed by an inhalation
- Cloud of water droplets
- Identification technique
- Vary in height, shape and visibility.
- In small cetaceans – rarely seen
- Weather- dependent



7. Wake/Bow-riding

- Favourite past-time of dolphins
- Form of play
- Jostle for best position in front of vessels
- Good opportunity of observing the particular species



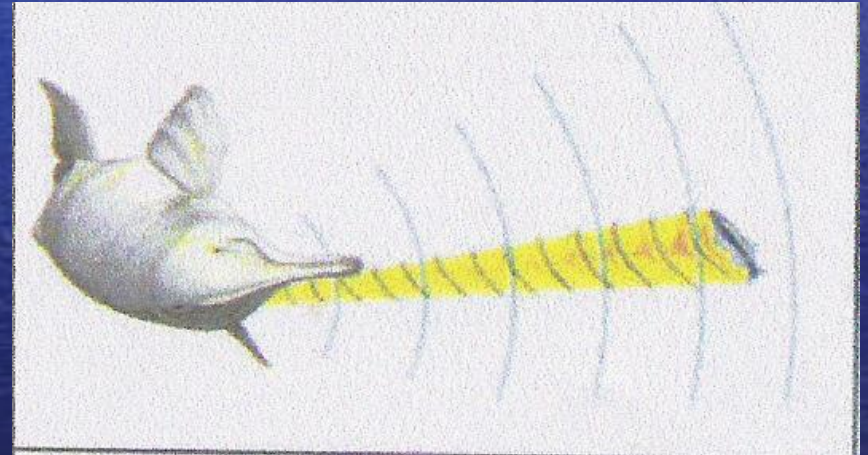
8. Logging

- Form of rest
- Floating motionless at the surface, facing the same direction



9. Echolocation

- Use of sound to locate objects such as prey
- Communication
- Navigation
- Noises emitted bounce back from any objects in the vicinity



How are cetaceans monitored?

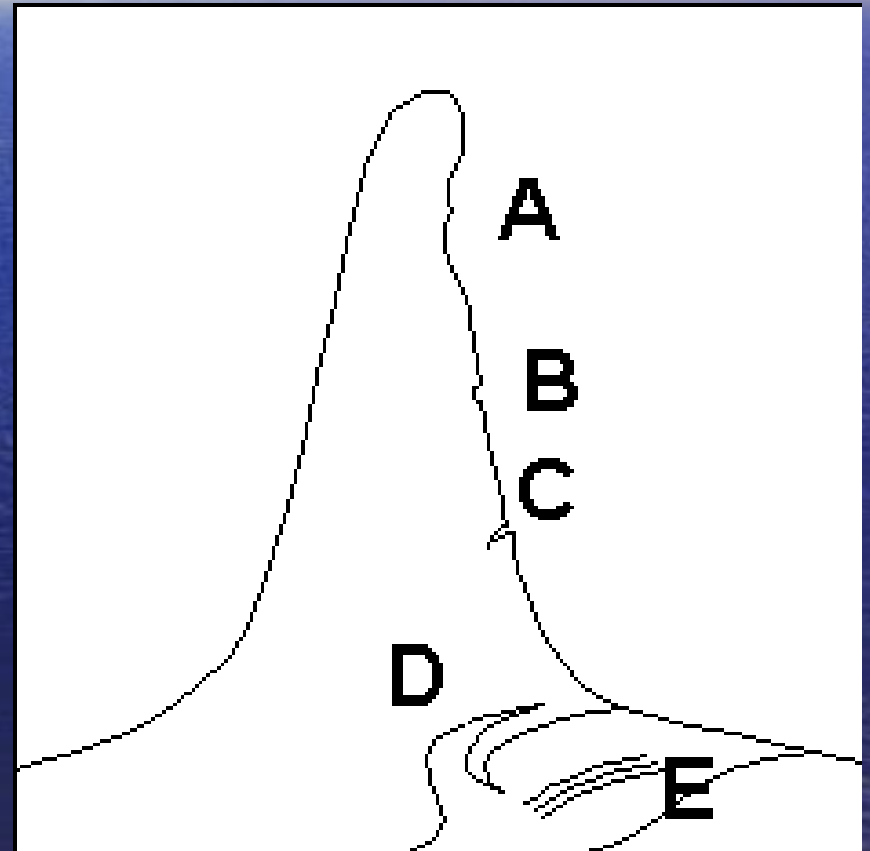
1. Photo-identification
2. Shore/land-based observations
3. Vessel-based observations
4. Tagging
5. Bioacoustic methods

1. Photo-identification

- Brief glimpses
- Michael Bigg – Killer Whales in the 1970's
- Characteristic shapes and sizes of dorsal fins, injuries, scars and pigmentation
- Individuals can be identified, counted and movements recorded

Photo-identification

- **A** = tissue loss
- **B** = nicks
- **C** = tears
- **D** = saddle patch
- **E** = scars
- **F** = significant deformities



A = Tissue Loss

- Injuries to the dorsal fin for example can leave recognisable marks



B = nicks

- Usually on the trailing edge of the fin



C = Tears

- Damage to the thin trailing edge, without tissue loss



D = Saddle Patch

- Like a human fingerprint. Unique to each whale. Found directly behind dorsal fin.
- Pigment lighter than body tone



E = Scars

- Scarring often leaves distinguishing identifiable markings



F = significant deformities

- Significant damage to dorsal fins for example can lead to permanent disfigurement
- Easily recognisable





(Oakley, 2011)

2. Shore/Land-based Observations

- Marine Organisations
- Land vantage points
- Training given; identification charts and data sheets provided
- Positive and negative results
- Databases established



Species Confidence: Definite: Probable: Possible:

Shore-based Surveys

- Constant effort watches
- Locations – Mumbles Head, Port Eynon Point, Oxwich Point and Burry Holms
- Behaviour

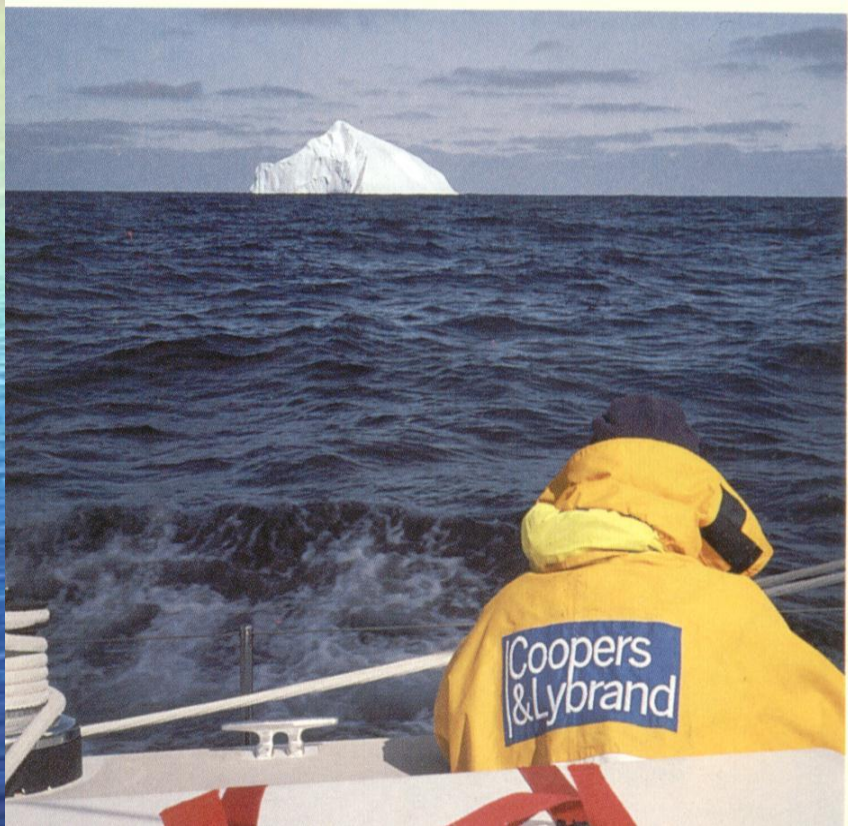


3. Vessel-Based Observations

- Offshore and oceanic habitats
- Small vessels, ferries, research boats
- Disturbance (Culik, 2000)
- Focal Observation survey
- Line transect
- Constant effort
- Challenge yachts races



Data Collection



Vessel-Based Transects



Behaviour		Description		Abbreviation	
Holding station/milling		Maintaining the same position through frequent turns, surfacing and dives		HS	
Breaching		An intentional leap, where at least 40% of body leaves water, re-entering head first		B	
Tail slapping		Raising flukes above surface and slapping them down forcefully		TS	
Logging		Resting at surface, almost motionless		LO	
Lunging		Rushing through water creating a surface wave, but head does not clear water		LU	
Fluking		Raising tail above water prior to a dive		FL	
Rapid Porpoising		Rapid swim action where entire body leaves water. Entry and exit is headfirst		RP	
Slow surfacing		‘Typical’ porpoise forward roll motion.		SS	
Ramming/somersault		Physical contact between two porpoises where one is catapulted out of water		R	
Fish seen while being pursued		Where fish can be seen at surface when being pursued		F	
Seabirds associated with observation		Seabird association, either on water or circling above and diving		SB	
Heading away from vessel		Changing direction and moving away from approaching boat, sometimes out of area		HA	
Approaching vessel		Changing direction and moving towards approaching boat		A	
Travelling		Directional and persistent movements at constant speed.		T	

Behavioural Interpretations (Ribeiro *et al.*, 2005, Bristow and Rees, 2001; Lusseau and Higham, 2004)

FEEDING	Cooperative hunting; chasing fish; circling; parallel swim formation; fast, directional and synchronised movements; associated seabirds
FORAGING	Repeated unsynchronised dives, in different directions, in a determined location
RESTING	Very slow movements or stationary at the surface
SOCIALISING	Frequent physical contact; vigorous movements and aerial behaviour such as breaching; playing – rolling at surface, particularly young animals
AGGRESSION	Lashing out with tail flukes perhaps to protect a calf, calves being tossed into the air by a conspecific
TRAVELLING	Directional and persistent movements at a constant speed.

4. Tagging



- Direct contact
- First introduced in Bergen in 1999
- Satellite tag transmitters
- Argos system
- Signals transmitted when animal surfaces
- Limitations
- Date, time, latitude, longitude, dive depth
- Expensive!
- Altering natural behaviour?

5. Bioacoustic methods

- Study of sound in non-human animals
- Nick Tregenza – detection and logging of sonar clicks
- The T-POD/C-POD
- Robust
- Generates no disturbance in situ



POD

- Cylindrical housing
- Ceramic hydrophone
- Signal processing unit
- Immersion switch
- Memory and data transfer connections



POD

- Listens through transducer embedded in wall
- Detects clicks comparing frequencies
- Trains
- Porpoise clicks – 120-150kHz 9 cycles
- Can distinguish between other noises in same band such as shrimps and boat propellers
- Towable

● Personal Study:

- Consider the paper from Embling *et al.*, 2010 entitled: Using habitat models to identify suitable sites for marine protected areas for harbour porpoises (*Phocoena phocoena*).
- Also paper provided on using suction cap tags when studying whale and dolphin diving behaviour.
- Evaluate which observational techniques are suitable for the monitoring of harbour porpoise populations.....