Monitoring for the MSFD: Requirements and Options

Nikolaos ZAMPOUKAS

European Commission - DG JRC
Institute for Environment & Sustainability
Water Resources Unit

European Commission

Contents of the presentation

- Legislative background
- Concepts and examples of integrated monitoring
- Large scale and less applied monitoring approaches
- JRC monitoring activities on contaminants & litter

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What is monitoring?

The **systematic measurement** of **biotic and abiotic parameters** of the marine environment, with **predefined spatial and temporal schedule**, in order **to produce datasets** that can be used for **application of assessment methods** and derive credible conclusions on whether the **desired state is achieved** or not for the marine area concerned

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What is included in monitoring?

- Choice of the parameters to measure
- Location of sampling sites
- Periodicity of sampling
- Processing of the samples
- Measurement of the parameter value

Calculation of metrics and classification not included (but related)

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In a nutshell....

Monitoring should provide the data to allow assessment methods to classify a marine area as reaching or failing to reach the desired status

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What monitoring is needed for the MSFD?

"…coordinated monitoring programmes should be established and implemented by **15 July 2014** in order to assess the environmental status of marine waters. Such programmes should include the indicative lists **of characteristics, pressures and impacts** of the Directive's Annex III, follow the specifications of Annex V and be able **to assess the achievement of environmental targets** that should be established in accordance with Article 10 by 15 July 2012."

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Annex III parameters

Phytoplankton (species compositions)
Zooplankton (species compositions)
Angiosperms (biomass & species composition)
Macroalgae (biomass & species composition)
Zoobenthos (biomass & species composition)
Fish (abundance, distribution age / size structure)
Reptiles (range, population dynamics, status)
Seabirds (range, population dynamics, status)
Marine mammals (range, population dynamics, status)
Other protected species (range, population dynamics, status)
Genetically distinct forms of native species (occurrence, distribution, abundance)
Habitats' (predominant, special, protected and endangered) characteristics

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Annex III parameters

Currents, wave exposure, depth, ice cover, mixing characteristics, residence time, salinity, seabed (topography, bathymetry, structure, substrata composition), temperature, turbidity, upwelling

Abrasion, extraction, sealing, changes in siltation
Contaminants (concentrations and biological effects)
Oxygen, temperature & pH
Marine litter & underwater noise
Introduction of microbial pathogens
Introduction of non-indigenous species (occurrence, distribution, abundance, transolcations)
Selective extraction of species

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What monitoring is needed for the MSFD?

COM DEC; 2010/477/EU lists **29 criteria** and **56 indicators** to assess GES for each descriptor of the MSFD

Data ON THE Annex III parameters should allow for the calculation of the 56 indicators related to the 11 Descriptors

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Marine monitoring also needed for:

the Water Framework Directive (WFD)
the Environmental Quality Standards Directive (EQS)
the Habitats Directive (HD)
the Birds Directive (BD)
the Common Fisheries Policy (CFP)
The Regional Seas Conventions (RSCs)

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What is integrated monitoring?

A monitoring programme providing data:

- For different MSFD descriptors and indicators
- For different pieces of legislation
- For more than one Member State
- Collected in a comparable way

Cost efficiency

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Integration across descriptors & indicators

E.g. data on fish stocks could also be used for biodiversity, alien species and food chain descriptors &
data on benthic flora both for biodiversity and eutrophication

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Integration across pieces of legislation

Existing marine monitoring programmes to be amended to also cover MSFD requirements

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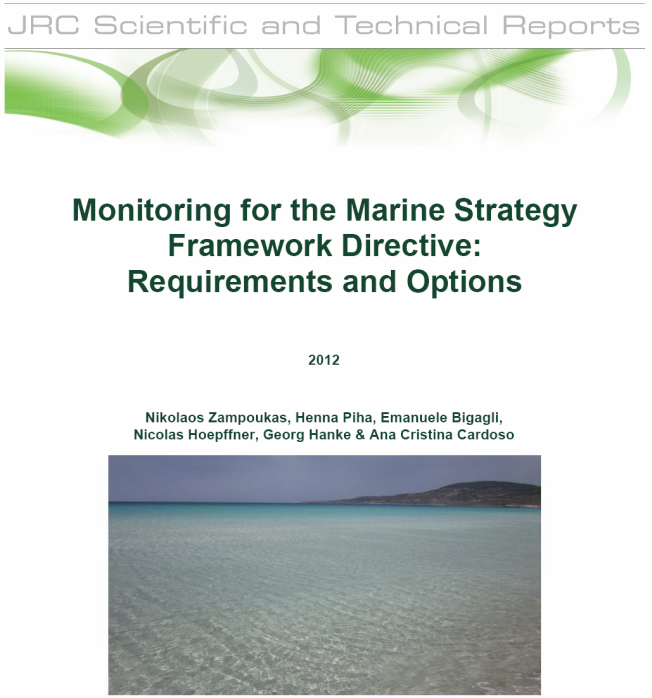
What is already monitored?

For many of the MSFD indicators data should already be collected under other pieces of legislation



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Gaps in required monitoring

Genetic structure of populations
Size spectra of the benthic community
Litter & Noise
Not all species and habitats are being monitored
Not all indicators operational/ monitoring requirements not always clear/ more parameters may be needed

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Differences in spatial requirements

WFD: coastal waters (up to 1 nm)
EQS: territorial waters (up to 12 nm)
HD & BD: where listed species and habitats occur
CFP: where fish stocks and fishing activities take place
MSFD: all territorial waters and Exclusive Economic Zones

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Considerations of frequency

WFD: every 1 month (priority substances), 3 years (macrobenthos) and 6 years (morphology)
EQS: at least every 3 years
HD: at least every 6 years
BD: at least every 3 years
CFP: yearly or every 3 years
MSFD: not defined but the MSFD cycle has a 6 years periodicity
Frequency should be parameter specific

Integration across Member States

Joint cruises and use of same instrumentation (e.g. UK SmartBuoy operating in NL waters)

Joint research projects (e.g. PERSEUS)

Joint development of assessment methods (e.g. OSPAR EcoQOs)

Collection of data in a comparable way

ew existing ISO & CEN standards:
chlorophyll-a
phytoplankton
hard-substrate benthic communities

Some agreed methodologies exist but not for all indicators and marine regions
Mostly for coastal waters

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Large scale and other less applied monitoring approaches

- Moorings and buoys
- Continuous Plankton Recorders
- Underwater video & Imagery
- Underwater acoustics
- Remote sensing
- Autonomous underwater vehicles and gliders
- Ships of opportunity/FerryBox

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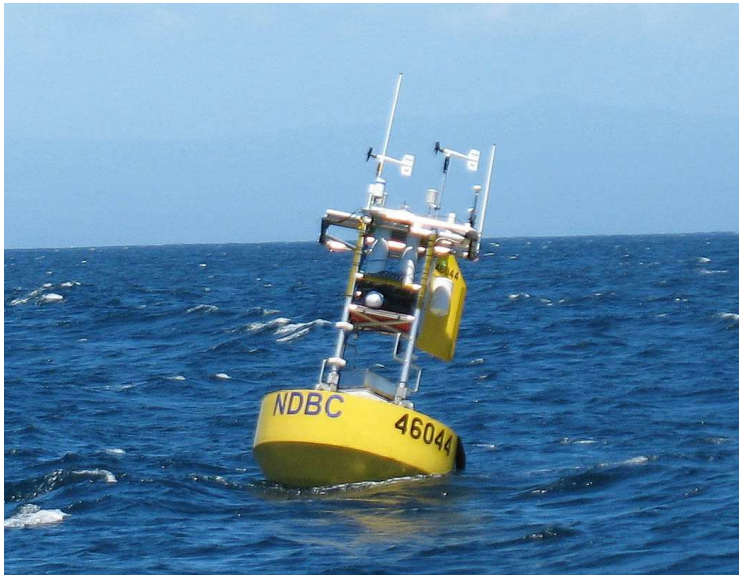
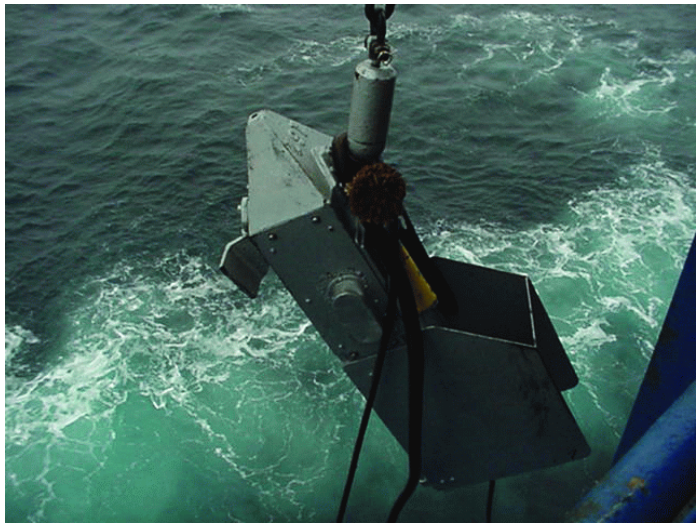
Buoys



courtesy of Paul Coenen (MBARI)

- Moored or free-floating
- Solar storage batteries
- Environment-friendly antifouling coatings
- Measurements in different depths
- temperature, turbidity, dissolved oxygen, trace metals, pCO2
- Real-time transmition of data in land-based observatories via satellite

Continuous Plankton Recorder



http://www.sahfos.ac.uk

- Plankton sampling instrument designed to be towed from ships at approximately 10 m
- Water passes through the CPR and plankton is filtered onto a slow-moving band of silk

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Continuous Plankton Recorder

In the laboratory CPR samples are analyzed in two ways:

- The Phytoplankton Colour Index (PCI), a semi-quantitative estimate of phytoplankton biomass, is determined for each sample

- Then, microscopic analysis is undertaken and individual phytoplankton and zooplankton taxa are identified and counted

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Continuous Plankton Recorder

- CPR can sample larger areas than other phytoplankton and zooplankton devices such as bottles and nets
- Data on biomass that are needed for many indicators can easily be taken while taxonomic identification needed for other indicators needs the same skills and human power as with any other sampling method
- CPR has also been used to monitor microlitter in the water column. However the CPR samples at approximately 10m depth and so will not sample floating debris

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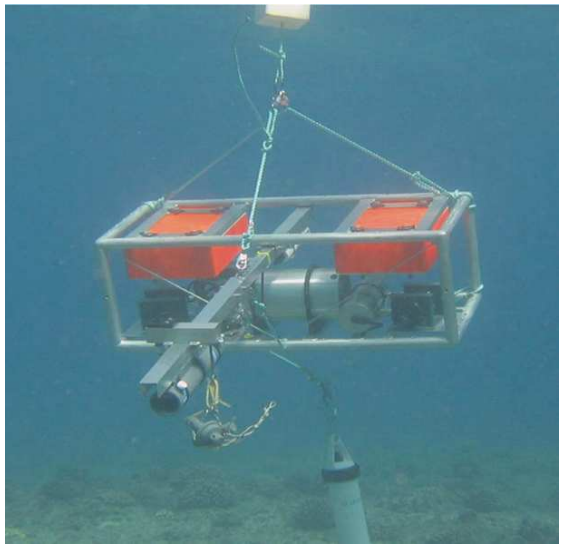
Underwater video & Imagery



http:noaa.gov

Information on:

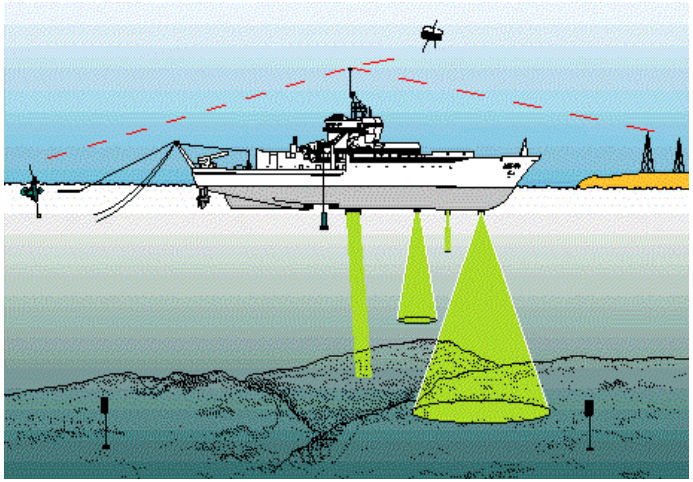
- structure of the sea-bed
- composition and abundance of macroscopic benthic and pelagic biota
- non-living items, such as litter

Underwater video & Imagery

http://www.marine.ie

Counting of *Nephrops* burrows in Ireland where an underwater video camera is towed over the sea bed for around 200m

Underwater acoustics



Source: http:noaa.gov

Sonars for:

- detection of animal and plant populations
- information on their abundance, size, behavior and distribution
- habitat mapping (depth, bottom roughness and hardness reflecting differences in sub-stratum types)
- 3D images possible

Need for validation with other devices (e.g. cameras)

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Underwater acoustics

Photograph by Brian J. Skerry-national geographic

Recording of sounds produced by marine animals (mainly mammals) could possibly provide info on their population abundance, their movements and location of their habitats. A related project is running in Catalonia: http://listentothedeep.com/

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Remote sensing

Earth Observation from satellites carrying optical sensors provides information at unprecedented time scales over large and distant areas of the world ocean in a real cost-effective way, where only few observations can be conducted by traditional methods using oceanographic vessels

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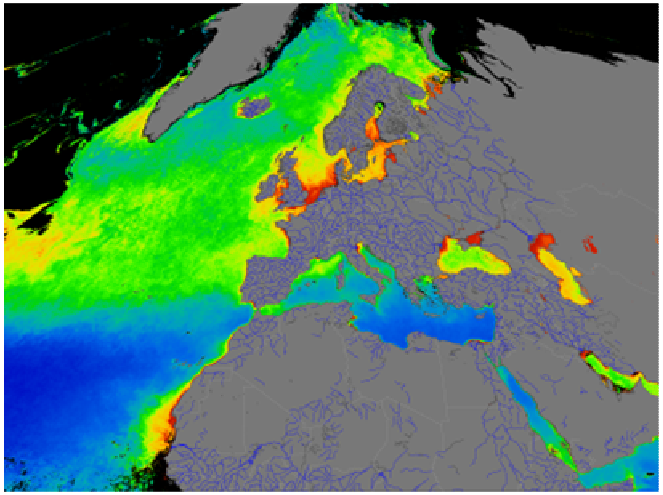
Remote sensing



http://emis.jrc.ec.europa.eu

Info on:

- Chlorophyll
- total suspended matter
- pigmented fraction of dissolved organic matter
- phytoplankton functional groups

Data accessible freely through space agencies or via specific web sites such as the **Environmental Marine Information System from the Joint Research Centre**

http://emis.jrc.ec.europa.eu

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Autonomous underwater vehicles

http://www.ego-network.org

AUVs are free-swimming torpedo-shaped devices remotely operated from the surface, most often powered by rechargeable batteries and/or buoyancy-based techniques (gliders)

Can cover large distance (ca. 10 miles) at various depths to provide a 3D view of the water column

Autonomous underwater vehicles

http://www.ego-network.org

Physical and bio-optical instruments:

- Nutrients
- Contaminants
- Phytoplankton biomass
- Temperature
- Oxygen
- Conductivity

Video-cameras:

- Organisms (mostly pelagic)
- Debris

Detectors of passive acoustic signals:

- Mammals

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Ships of opportunity

Use of volunteer ferries, cruise ships and merchant vessels to gather oceanographic data

Various instrumentations to collect data related to physical, chemical and biological

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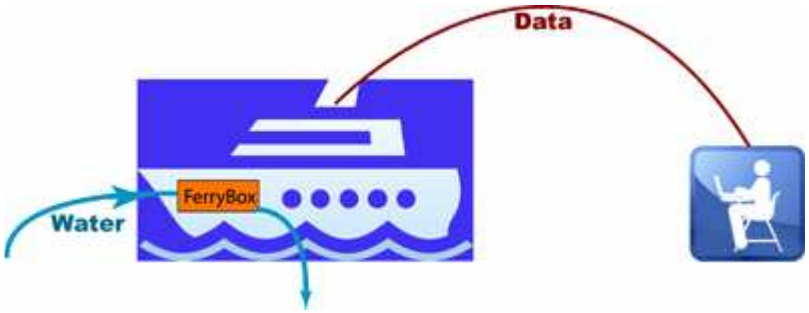
FerryBox



http://www.ferrybox.org/

Automatic flow-through system pumping sea water on the side of the ship and propelling it in a internal loop at constant velocity to conduct the various measurements

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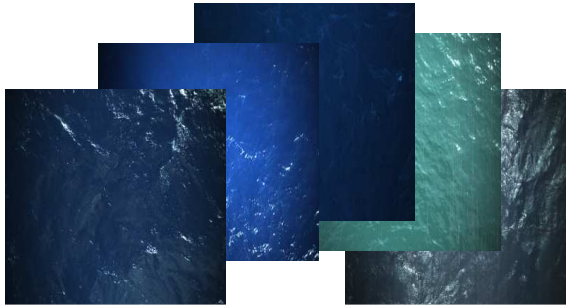
JRC pilot research on monitoring of floating meso litter (2.5–30 cm)

- Camera on cruise ship, weekly travelling around Western Mediterranean
- 4 images/sec =600000 images/3 weeks campaign = 1300 km transect with overlapping images
- Image analysis for object recognition



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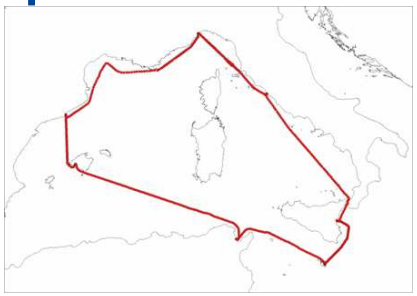
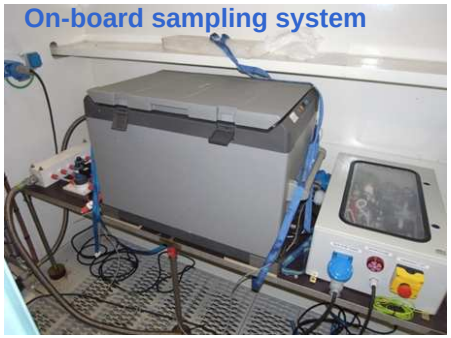
JRC transect surface water sampling for contaminants

- Autonomous sampling system on cruise ship
- Sampling in predefined sites
- **Ultra trace** analysis of contaminant concentrations possible & successful
- Ship environment does not affect quality of sample



On-board sampling system



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In conclusion

Marine monitoring:

- is needed for several pieces of EU and other legislation - MSFD requires some additional one
- should be integrated in order to also be cost effective
- could be facilitated by large scale approaches

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Thank you for your attention