Riverine Litter Monitoring

Options and Recommendations

MSFD GES TG Marine Litter Thematic report

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Introduction

- MSFD Descriptor 10 – Marine Litter
- High concern on litter pollution, and particularly plastics!
- Need to identify and quantify sources of litter and their pathways to the marine environment - Very limited knowledge and data
- Need for harmonized methodologies that can be used to provide quantitative data for comparable assessments
- Research on the topic is ongoing and starting. Additional knowledge is expected soon

A comprehensive overview about monitoring options is needed in order to prepare harmonization of approaches

Marine Strategy Framework Directive

MSFD 2008/56/EC

- Good Environmental Status (GES) of EU marine waters by 2020
- 11 thematic descriptors
- Common Implementation Strategy (CIS) – 6 years cycle

Support to MSFD implementation process

MSFD Technical Group on Marine Litter

nominated experts from EU Member States + additional experts in the field

Finalization of 4 thematic reports on:

Sources, Harm, Riverine litter and Modelling

➢ Riverine Litter Monitoring (thematic report)

- to compile options for monitoring of riverine litter
- to provide first recommendations on monitoring approaches and methodologies
- to provide indications on the issues which need to be further developed

Riverine litter

Litter in the river water body and river banks

Sources

- Inputs of litter to the riverine system
- Pathways are complex with multiple factors involved

Composition

- Mostly anthropogenic polymers (plastics)
- Macro litter: **MSFD Master List of Categories of Litter Items***
- Micro litter: chemical composition and shape

Properties

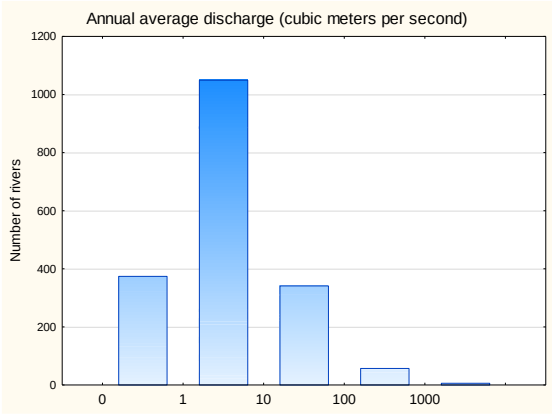
- Different sizes, density, shapes and natures
- Litter properties vs. river hydrology → influence on buoyancy

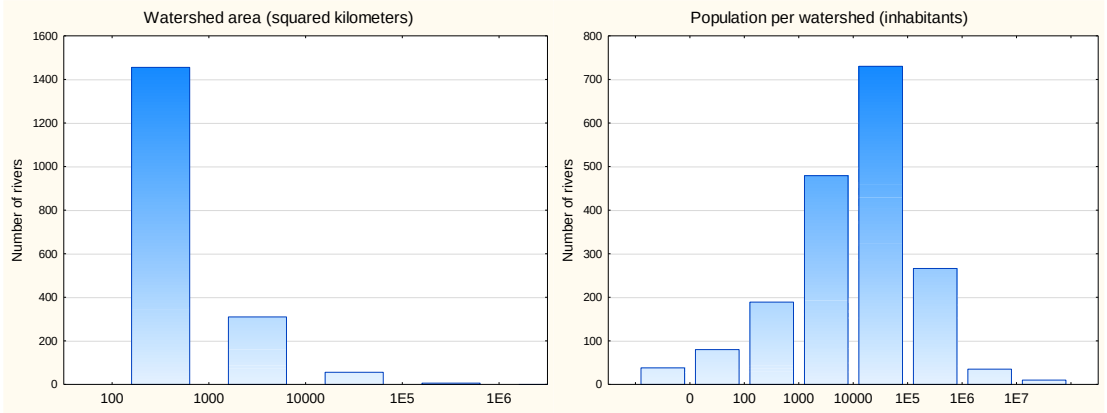
Litter collected in Danube study (Hohenblum et al., 2015)

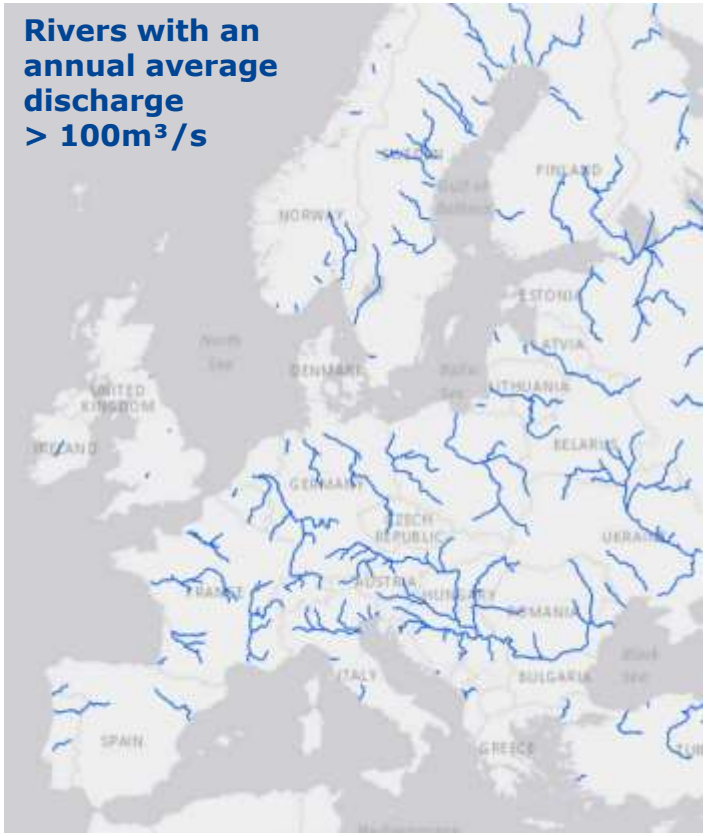
*EC JRC, 2013. MSFD Technical Subgroup on Marine Litter. Guidance on Monitoring of Marine Litter in European Seas.

Rivers

Great variety of rivers: length, catchment size, population, catchment characteristics, meteorological/climatic differences and the level of their management







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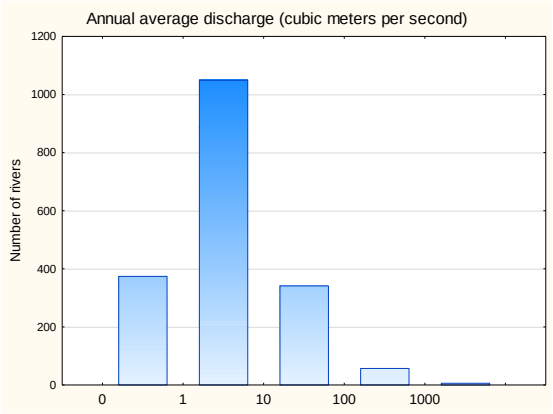
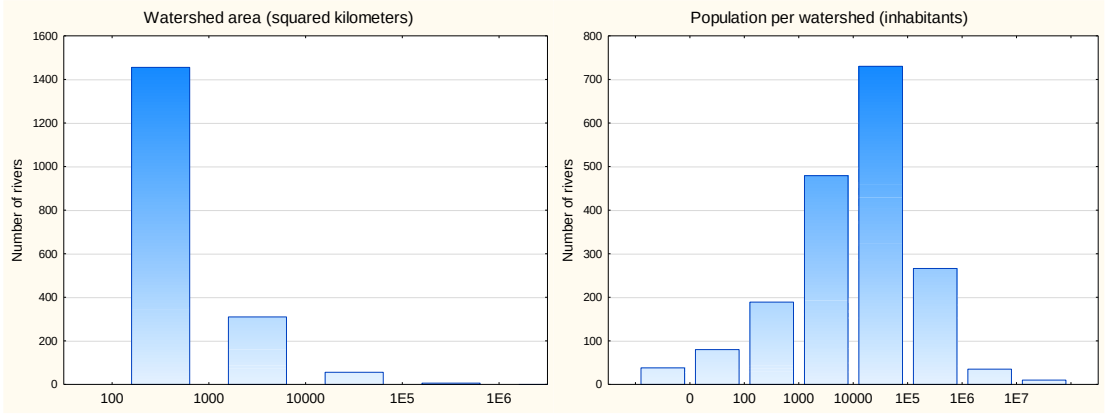
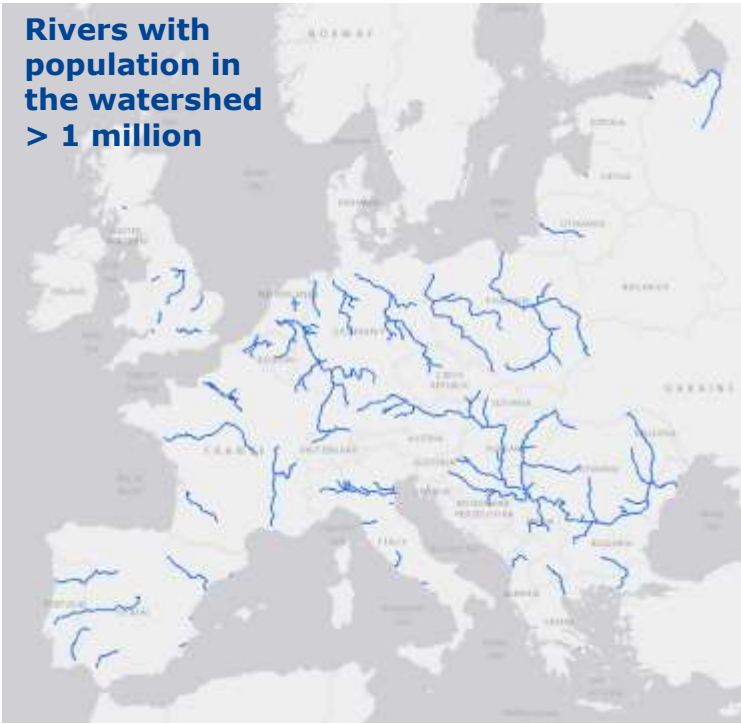






Rivers

Morphology

- The pathway of litter in a river is related to its (geo) morphological characteristics, channel/bed and those of the catchment:

Main characteristics

Width
Depth
Transect shape
Bottom gradient

→ **Influence on litter transport** ←

Degree of:
Sinuosity
Braiding
Anastomosing

- Artificial structures (e.g. dams, locks,…)
- Abundance and type of vegetation

Picture: Gary Evans

Hydrology

- Determined by river shape and the meteorological situation

Influence on litter transport

Discharge and Flow velocity | Windage | Tributaries | Tidal regime | Internal turbulence

Monitoring strategy

➢ Location

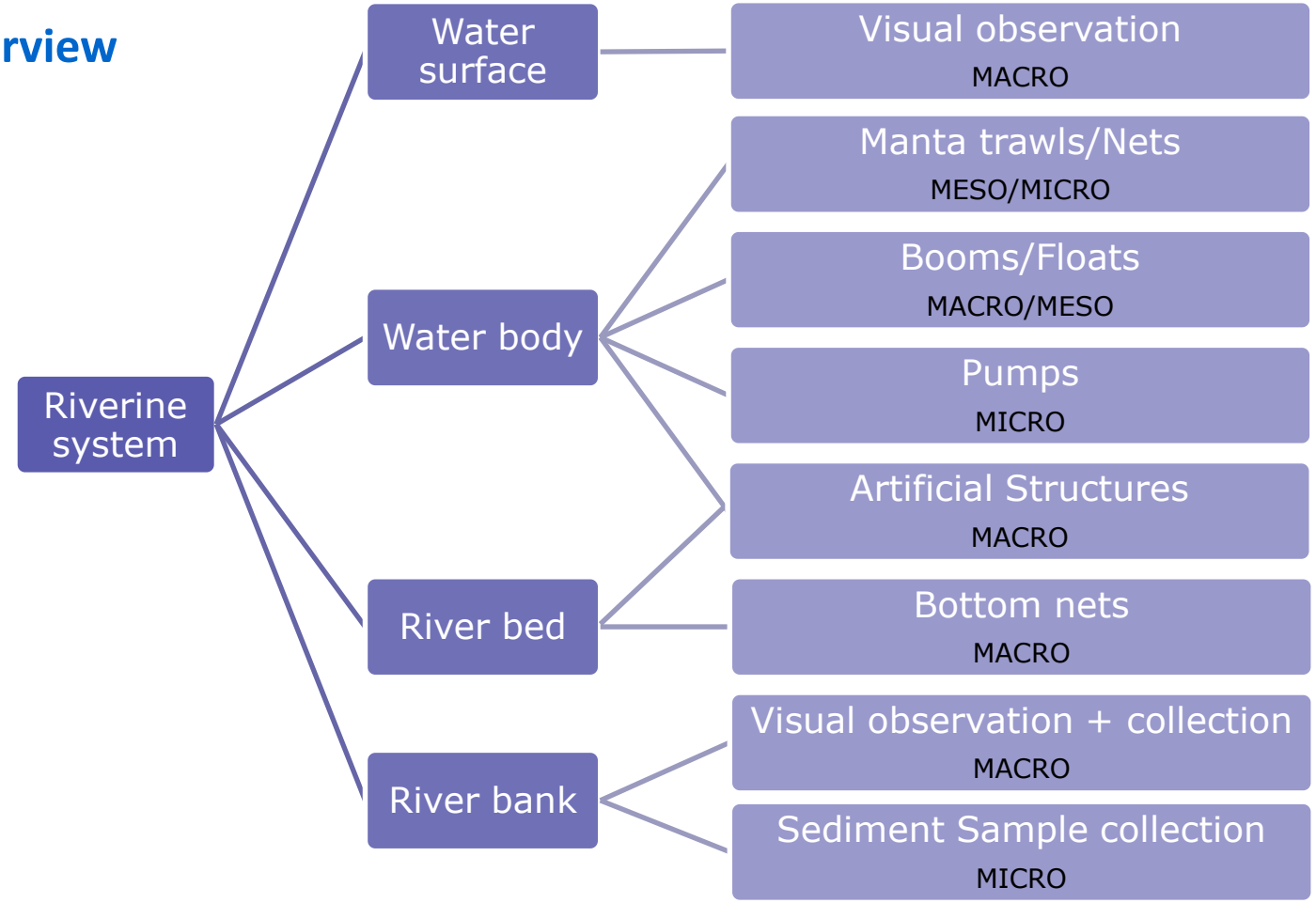
- Input of riverine litter into the sea – river/sea boundary (estuaries)
- Identification of sources and hot spots - investigative upstream sampling locations

➢ Timing

- High temporal variability in the amount of litter: sources and environmental conditions.
- Short term monitoring vs. Monitoring integrating over time
- Coverage of peaks of litter: source emission peak, flushing events (e.g. floods)
- Need better understanding of river litter pathways. Adapting monitoring strategies to incorporate new knowledge and tools

Monitoring methods

Literature overview



Monitoring methods

Table XXX. Scientific studies using collection methodologies for litter in the riverine water body

Litter collection in water body				
Author	Device opening dimension, mesh size	Monitoring depth	Monitoring method	Unit
Moore et al., 2011	90x15 cm, 333 µm	top 15 cm	Stationary manta trawl, crane to sample in the middle of the channel. 3 replicates of 15 minute trawl (or until clogging of net) at each site. Flow rate measured by flow meter or floating objects. Fractions separated with Tyler sieves (4.75 mm, 2.8mm and 1.0mm mesh).	items/m³
	46x25 cm and 43x22 cm, 0.8 mm; 46x25 cm , 333 µm	n.a.	Stationary hand nets (0.8 mm mesh and opening 46x25 cm; 0.8 mm mesh and opening 43x22 cm) to sample in the edge of the channel and heavy rectangular net (333 µm mesh and opening 46x25 cm) dropped from a bridge. Replicates, time and fractions separation as described for manta trawl.	items/m³
Faure et al. 2012	60x25 cm, 300 µm	top 25 cm	Dynamic manta trawl. Trawl distance 3.7 km trawl. Sieving (5 mm mesh) in the laboratory to separate micro from macro.	g/km², items /km²
van der Wal et al., 2013	n.a., 3.2 mm	top 10 cm; 10-60 cm	Waste Free Waters (WFW) sampler from MosaPura project: a cage-like construction mounted on a pontoon with 2 nets (3.2 mm mesh) which sampled floating and suspended litter (10-60 cm depth).	m³ macroplastics/year (estimations based on assumptions)
Eriksen et al., 2013	61x16 cm, 333 µm	top 16 cm	Dynamic manta trawl. Trawl distance calculated with onboard speedmeter during 60 minutes surveys. Litter fractions separated in the laboratory by Tyler sieves (0.355–0.999 mm and 1.00–4.749 mm and >4.75 mm).	items/km²
Faure et al. 2014	60x18 cm, 300 µm	top 18 cm	Dynamic manta trawl. Mechanical flow meter attached at the trawl opening. Lake sampling: trawl distance 3-4 km to filter 320-430 m³ of surface water (speed of 1.5 m/s, 3 kn). River sampling: Trawl attached on a ridge for 15-30 mins. Micro and macro fractions separated in the laboratory by sieves (> 300 µm, >1 mm and > 5mm).	Lake: mg/km², items/km²; River: item/m³, mg/m³, items/h, mg/h
Free et al., 2014	61x16 cm, 333 µm	top 16 cm	Dynamic manta trawl. Trawl distance 3.1-4.1 km, 60 mins at a speed of 3.5 kn. Litter fractions separated in the laboratory by sieves (0.355–0.999 mm and 1.00–4.749 mm and >4.75 mm).	items/km²
Midburst et al., 2014	n.a.	n.a.	Characterization of debris collected by trash booms near the river mouth.	Weight
Morritt et al. 2014	n.a.	bottom 40 cm	Standard and modified eel fyke nets anchored to the river bed with 40 cm diameter ring. Nets installed parallel to shoreline in line with tidal direction. Monitoring during 3 months fishing program.	Total number of items during fishing program
Lechner et al., 2014	0.5 m diameter, 500 µm	top 50 cm	Stationary conical driftnets (1.5 m long) (covering 60% of total column most cases). Flow meter attached to the net. Simultaneous replicates done at both margins of the river (25 m distance to the shoreline). Samples collected hourly for circadian periods. Items classified as mesodebris (2-20 mm) and microdebris (<2 mm).	items/1000 m³, g/1000 m³
Sadri and Thompson, 2014	50x15 cm, 300 µm	top 15 cm	Dynamic manta trawl. 3 replicates samples for both ebb and flood periods. Net towed against the tidal flow at a speed of 4 knots for 30 min during the maximum flow period. Samples sieved in the laboratory and items categorised as >5 mm, 3–5 mm,1–3 mm and < 1 mm.	items/m³
Jang et al., 2014	n.a., 5 mm	n.a.	Netting of floating debris (mesh 5 mm) at the mouth of the river.	Weight
Hohenblum et al., 2015	30x60 cm and 60x60 cm, 250 and 500 µm	Surface, midwater, bottom	Stationary driftnets system with 5 nets (mesh size 250 µm and 500 µm) at different depths: 1 at the bottom (sediment trap with 30x60 cm opening), 2 at middle water (60x60 cm opening) and 2 at the surface (60x60 cm opening). Monitoring surveys of 45-60 minutes, with flow meters attached to the nets at each depth.	Concentration (g/1000 m³); fluxes (g/s and kg/d, tons/year)
Tweehuysen, 2015	Surface net 100x10 cm and suspension net 100x50 cm, 3.2x3.2mm mesh, trapping items > 4.5 mm	top 10 cm + 20-70cm	Trawling transects sampling with Waste Free Waters (WFW) sampler on the side of the boat. Doppler current meter used to measure relative speed. WFW sampler is a cage-like structure with 2 nets: a 1 m wide surface net	items/ km², items/million m³
van der Wal et al., 2015	60x10 cm, 330 µm	top 10 cm	Stationary Manta trawl, Trawl from river bank for maximum 30 minutes. Analysis restricted to <5 mm particles.	items/km², g/km²
	n.a., 330 µm	30 cm	Stationary pump-manta net method to filter 5000 L by pumping water into a container using the manta net as sieve. Analysis	items/km², g/km², items/m³, g/m³

Joint Research Centre

Monitoring methods

River surface observation – floating litter (macro)

- Severe lack of data for riverine litter
- Straightforward method – surface as proxy for water body
- Visual monitoring data + river flow data = Estimation of litter flux
- RIMMEL project approach

Ticino river (Italy). Testing of the RIMMEL app. for Floating Macro Litter monitoring

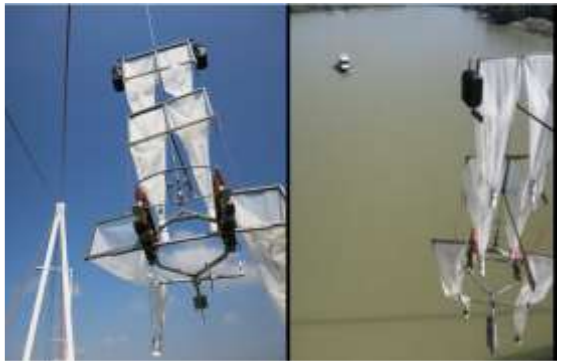
Adour river(France). Testing of the RIMMEL app. by Surfrider Foundation Europe

Monitoring methods

River water body – floating and suspended litter (macro, meso and micro)

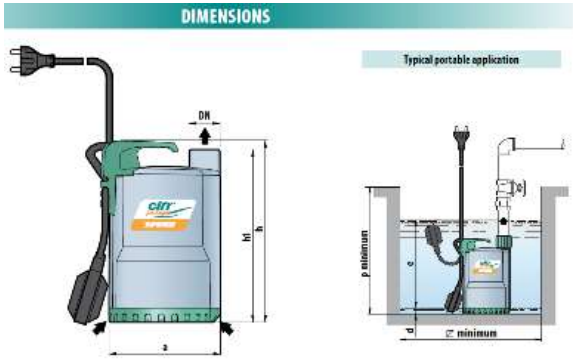
- Collection of floating and suspended litter is done by filtration of river water

Manta Trawls/Nets



Sampler used in Danube study (Hohenblum et al., 2015)

Pump filtration systems



Pumping system scheme (van der Wal et al., 2015)

Booms and floats (macro)

Floating booms network in Paris (Gasperi et al., 2015)

Monitoring methods

River bed – collection in bottom water - suspended and tumbling litter

Bottom nets / fishing nets (macro)

Fyke net set in the River Thames
(Morritt et al., 2014)

Commercial stow nets
(Schulz et al., 2014), from Scholle & Schuchardt (2012)

Streambed sampler (micro)

Streambed sample hold on a crane
(Moore et al., 2011)

⇧

Net dimension:
can cover an important section of the water column, not only bottom

Monitoring methods

Artificial structures – opportunity for monitoring!!

- Dams and other flow regulatory structures - cleanup works
- Hydroelectric powerplants – screening/filtering systems

Monitoring methods

River banks

Macro (meso) litter on river banks

- Direct observation, collection and documentation
- Abundance and composition analysis – citizens science

Micro (meso) litter on river banks

- Collection of sediment samples using sieves, cores, grabs, containers
- Further analysis in the laboratory

Data

Data acquisition protocols	• Use of agreed harmonised methodologies in order to provide comparable results
Data units and format	• Common format for riverine litter fluxes - database • Macro litter - MSFD Marine Litter Category list
Data quality	• Data quality information should be available • Estimates about data uncertainty should be reported
Metadata	• Interpretation and use of data on marine litter fluxes • E.g., location, precipitation, river flow data, river section
Data storage and availability	• Available and accessible in order to allow collaborative approaches, analysis of data and prioritization of efforts

Need for harmonization and agreement at international level (River Commissions, RSC, EU and UN and be readily available to everyone.

Recommendations

General

- Additional scientific knowledge needed
- Regional coordination of Member States and EU neighbouring countries with Regional Sea Conventions and River Basin Commissions and authorities

Research

- Numerous knowledge gaps to be filled
- Analysis of existing/ongoing research outputs
- Commissioning dedicated research to answer defined questions

Monitoring

- No agreed monitoring methodologies available
- Guidance and Protocols for monitoring needed
- Metadata requirements and reporting units to be agreed at international level

➢ Riverine Litter Monitoring (thematic report)

- Close to finalization
- Submitted to GES meeting for comments
- Upcoming last round of comments from MSFD TG Marine Litter
- It will be publicly available as JRC Technical report

Keep track of MSFD TG Marine Litter publications on the MSFD Marine Competence Center (MCC) website:

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

Thanks!!

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