

Supplementary Information

Microplastics in sea surface waters in the Southern Bight of the North Sea

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Figure S1: Neuston Catamaran with hulls and sampling net. Catamaran was towed on a 50 m cable behind the boat (starboard side) to avoid contamination and waves from the boat.

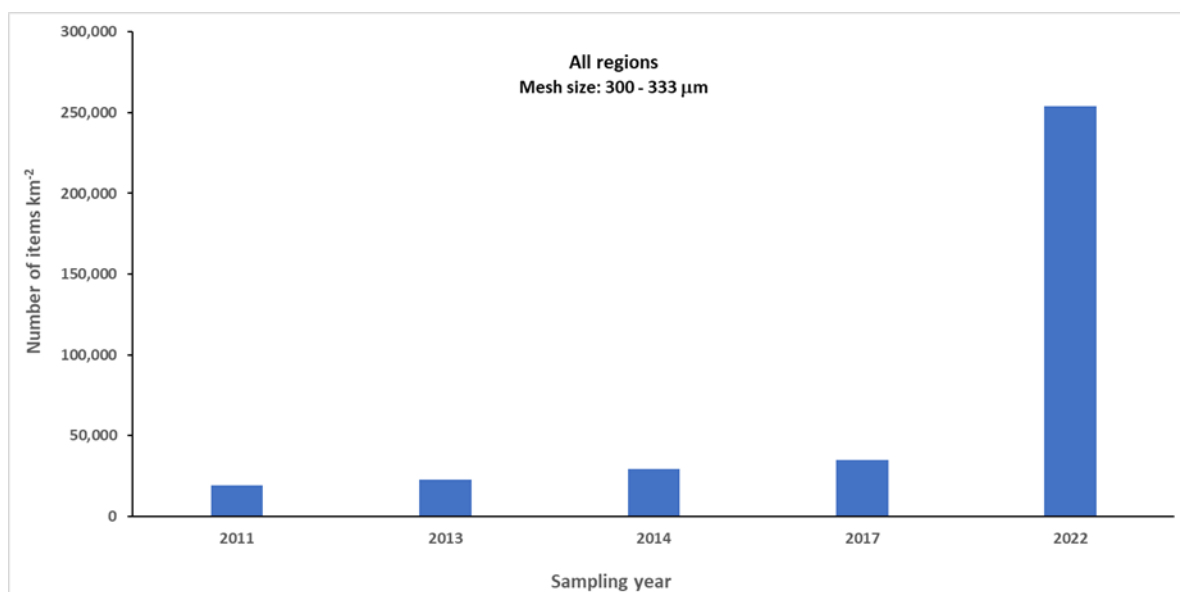


Figure S2: Number of microplastic items per km^2 in OSPAR areas from 2011 to 2022. All surface water samples were collected with a net of the mesh size 300 to 335 μm .

Table S1. Sampling stations and number, concentrations in items Km⁻² and items m⁻³ of micro- meso- and macroplastic particles at each location. The total, average and standard deviation (± SD) of all stations is also provided.

	Sam ple No	Microplastic items counted	Microplastic items km ⁻²	Microplasti c items m ⁻³	Mesoplastic items counted	Mesoplastic items km ⁻²	Mesoplasti c items m ⁻³	Macroplastic items counted	Macroplasti c items km ⁻²	Macroplasti c items m ⁻³
	1	73	3153.64	0.02	1	43.20	0.0002	1	43.20	0.0002
	2	308	9348.20	0.05	6	182.11	0.0009	0	0.00	0.0000
	3	215	6506.33	0.03	8	242.10	0.0012	7	211.83	0.0011
	4	87	4075.77	0.02	10	468.48	0.0023	9	421.63	0.0021
	5	449	25462.00	0.13	28	1587.83	0.0079	19	1077.46	0.0054
	6	489	20920.82	0.10	50	2139.14	0.0107	18	770.09	0.0039
	7	126	3576.90	0.02	1	28.39	0.0001	0	0.00	0.0000
	8	147	7201.28	0.04	14	685.84	0.0034	2	97.98	0.0005
	9	192	6906.32	0.03	1	35.97	0.0002	4	143.88	0.0007
	10	240	8141.46	0.04	6	203.54	0.0010	0	0.00	0.0000
	11	15	755.74	0.00	0	0.00	0.0000	0	0.00	0.0000
Total		2341.00	96048.44	0.4805	125.00	5616.59	0.028	60.00	2766.07	0.0138
Avera ge		212.82	8731.68	0.0437	11.36	510.60	0.003	5.45	251.46	0.0013
SD		144.18	7278.94	0.0364	14.46	677.99	0.003	6.80	345.52	0.0017

Table S2. Polymer types (PP, PE, PS, Paint, Other as PA and rubber, PVC and Rayon) and polymer forms (fragments, filaments, film, bead, nurdle, foam) micro- meso- and macroplastic particles. See also Figure 5 and 6.

Polymer type	Microplastic	Mesoplastic	Macroplastic	Forms	Microplastic	Mesoplastic	Macroplastic
PP	39	51	25	fragment	199	45	1
PE	165	62	35	filament	14	43	47
PS	21	6	0	film	16	35	12
Paint	11	1	0	bead	19	0	0
Other (PA and rubber)	9	4	0	nurdle	5	2	0
PVC	0	1	0	foam	1	2	0
Rayon	2	0	0				

Table S3. Number of items in surface waters and near surface waters per cubic metre (m³) and squared kilometre (km²) reported in the literature for the OSPAR Maritime Area.

Region	OS PA R region	Sam pling year	Net/ge ar	Net/sieve mesh size (µm)	Number of items m ⁻³ (mean ± SD)	Number of items km ⁻²	Size range (µm)	Particl e type	Polym er type	References
Arctic polar waters	I	2014			0.34 ± 0.31 (0 – 1.31)					(A. Lusher et al., 2015)
	I	2015	Under way system (6 m depth)	80	2.4 ± 0.8		< 500 - 5000	Fibres (not consid ered), fragm ents	PE, OO, PVC, PS, EVA, PUR, PA	(Morgana et al., 2018)
HAUSGARTEN Observatory	I	2016	Large volume pump	32	0 – 1,287		> 11 (Main fraction ≤ 25)		PA, ethylene-propylene-diene rubber	(Tekman et al., 2020)
Faroës	I	2013			1.5					(A. L. Lusher et al., 2014)
Arctic waters	I	2017	seawater intake loops	63µm	40.5±4.4 particles/m ³		>10µm	fibres	Polyester, PET, nylon, PP,	(Ross et al., 2021)
North Atlantic (accumulation rate)	IV			150	1.7					(Reisser et al., 2015)
Northeast Atlantic		2013	Under way system	250	2.46		200-4320	Fibre, fragm ent,	n.s.	(A. L. Lusher et al., 2014)

			(3 m depth)					bead, foam		
North Sea	II	2013			1					(A. L. Lusher et al., 2014)
North Sea	II	2018	-in-house designed filtration system for 11-500 µm size range - microp lastic net for 500-5000 µm size range	- 10 (for 11-500 µm size range) - 300 (for 500-5000 µm size range)	5 – 40		< 500		Acrylates, PUR, varnish	(Roscher et al., 2021)
North Sea	II	2014		100	0.1 – 245.4		Mainly < 500		PP, acrylates, PUR, varnish, PA	(Lorenz et al., 2019)
Forth & Tay, Scottish Marine Region	II	2014-2020	Neuston net	335		0 – 83,789 (mean: 4449)				(Russell & Webster, 2021)

Firth of Forth (Forth & Tay, Scottish Marine Region)	II	2017	Manta net	330		0 – 8218 (mean: 2337)				(Santillo et al., 2018)
North Sea and Celtic Sea	II, III	2011	Manta net	333	0 – 1.5	0 – 376,000				(Maes et al., 2017)
Atlantic transect (European Coastal)	II, III	2014	Underway system (3 m depth)	300 and 10 (50 for regions with high suspended materials loads)	~ 300 (mean) (~120 – 500)		Majority < 40 µm	Fragments, fibres	PE, PP	(Enders et al., 2015)
Coastal NE Atlantic	III	2013			2					(A. L. Lusher et al., 2014)
Offshore N. Atlantic		2013			5					(A. L. Lusher et al., 2014)
Argyll, Scottish Marine Region	III	2014-2020	Neuston net	335		0 – 38,275 (mean: 8354)				(Russell & Webster, 2021)
Outer Hebrides, Scottish Marine Region	III	2014-2020	Neuston net	335		0 – 11,779 (mean: 1841)				(Russell & Webster, 2021)
West Highlands, Scottish Marine Region	III	2014-2020	Neuston net	335		0 – 47,009 (mean: 3262)				(Russell & Webster, 2021)
Shiant Isles (Outer Hebrides), Scottish Marine Region	III	2017	Manta net	330		0 – 15,397 (mean: 3163)				(Santillo et al., 2018)
NW Isle of Mull (Argyll, Scottish Marine Region)	III	2017	Manta net	330		0 – 627 (mean: 314)				(Santillo et al., 2018)
SW Isle of Mull (Argyll, Scottish Marine Region)	III	2017	Manta net	330		0 – 1834 (mean: 917)				(Santillo et al., 2018)
Tiree/Gunna Sound (Argyll, Scottish Marine Region)	III	2017	Manta net	330		0 – 4507 (mean: 1697)				(Santillo et al., 2018)
Rhum/Canna (West Highlands, Scottish Marine Region)	III	2017	Manta net	330		0 – 3620 (mean: 1829)				(Santillo et al., 2018)

Bay of Brest	III	Spring 2014 Autumn 2014	Manta net	335		29,450 ± 29,951 55,255 ± 73,475 (mean ± SD)	335 - 5000	Fragments, fibres, foams, thin sheets , pellets .	PE, PP PS	(Frere et al., 2017)
Bay of Biscay	IV	2013			2					(A. L. Lusher et al., 2014)
West Coast of Portugal	IV	2018- 2019	Neuston net	335	0.45 ± 0.52 (mean ± SD)	40,822.58 ± 43,578.63 (mean ± SD)	335-5000	Fragment, film, fibre, filament, bead	PE, PP, PS, PVA, Rayon, PEST, PUR, PAA, PA	(Rodrigues et al., 2020)
Portuguese coastal waters	IV	2002- 2008	Net/Neuston net/Longhurst Hardy Plankton Recorder (PR)	Net: 180 Neuston: 280 PR: 335	0.02 ± 0.016 (mean ± SD)			n.s.	PP, polyacrylate, PE	(Frias et al., 2014)
Costa Vicentina	IV	2007			0.036 ± 0.027 (mean ± SD)					(Frias et al., 2014)
Lisboa	IV	2008			0.033 ± 0.021 (mean ± SD)					(Frias et al., 2014)
Aveiro	IV	2002			0.002 ± 0.001					(Frias et al., 2014)

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Atlantic transect (European Offshore and Azores)	V	2014	Underway system (3 m depth)	300 and 10 (50 for regions with high suspended materials loads)	~ 190 (mean) (~100 – 350)		Majority < 40 µm	Fragments, fibres	PE, PP	(Enders et al., 2015)
Atlantic ocean	V	2015	Underway system (11 m depth)	250	1.15 ± 1.45 (0 – 8.5)		< 5000	Fibres, fragments	PEST, PET, PA, PP, PVC, PS, PUR	(Kanhai et al., 2017)
Jade bay, North Sea	II	2011	100mL PE bottles	40µm	64000±19400 0 granular particles and 88000±82000 fibres/m ³		>80µm	granules, fibres	NA	(Dubaish et al., 2013)
French slope and Armorican shelf, Bay of Biscay	IV	2017, 2018, 2019	neuston net	500µm and 300µm		2017: 2.52±1.86/km ² , 2018: 3.54±2.99/km ² , 2019: 3.70±2.34/Km ²	>300µm	NA	NA	(Ruiz et al., 2022)
Svalbard, Arctic waters	I	2017	neuston net	300µm	NA	NA	>20µm	filaments, fibres	PE, PP, PS, PVC, LDPE	(Dabrowska 2021)

German Bight, North sea	II	2016, 2017	onboard deck-wash system	20, 40, 63 and 125µm	2-1396µg/m ³		<1000µm	NA	PE, PP, PS, PVC, PC	(Dibke et al., 2021)
Greenland Sea, Arctic waters	I	2018	pump and plankton net	0.05mm	1190±280 items/m ³ and 2430±840 items/m ³		100-500mm	fiber	PE, PS, PP, PA, PVAc	(Jiang et al., 2020)
Isfjorden and St. Jonsfjorden, Arctic waters	I	2018	manta trawl, pump	333µm and 500-300-100µm	3.5 particles/m ³		100-5000µm	fibres, beads, fragments	PE, PP, Acrylic	(Carlsson et al., 2021)
Arctic waters	I	2017	manta trawl	335µm	0.06±0.04 particles/m ³		1050-4470µm	fragments, films	PE, PP, PMMA	(Hanninen et al., 2021)
Skagerrak, Kattegat, North Sea	II	2014	manta trawl, pump	300µm and 50µm	manta trawl: 0.04 particles/m ³ , pump 0.1particles/m ³		mainly 50-300µm	plarticle, fibres	PE, PP, PS, PA	(Schonlau et al., 2020)

Nuup Kangerula, Arctic waters	I	2019	bongo net and pump-filter	300µm and 10µm	pump: 142MPs/m ³ ; bongo:0.12 MPs/m ³		<300µm	fibers	Polyester, PE, PP, Nylon	(Rist et al., 2020)
Rockall Trough, NE Atlantic	V	2016	CTC system	80µm	water: 70.8 MPs/m ³		>52µm	fibers	Polyester, acrylic, PET, PE, cellulose	(Courtene-Jones et al., 2017)
Esposende, Doruro, Matosinhos, Leixoes, Bay of Biscay	IV	2016, 2017, 2019, 2020	planktonic taws, sample bottles	500µm	651±1660 MPs/m ³		1mm<majority<3mm	fibers, fragments, films	PE, PP, PET, PA	(Rodrigues et al., 2020)
from Vigo to Donostia, Bay of Biscay	IV	2006-2010	bottom trawl	20mm		43±33kg/km ² and 74±28 items/km ²	NA	pieces, foam	NA	(Lopez-Lopez et al., 2017)
Algarve, Bay of Biscay	IV	2018	neuston net	335µm	1.36±4.03 particles/m ³		NA	fibres, fragments	PAN, PA, PES, PP, PS, PVC, HDPE	(Lechthaler et al., 2020)
Chichester Harbour, North Sea	II	2018	plankton net	20µm	water: 8.2 particles/m ³		NA	NA	NA	(Outram et al., 2020)

NE Atlantic	V	2013	continuous intake	250µm	13.72 ± 0.51 particles/m ³		2.55 ± 0.03mm	fibres	NA	(Lusher et al., 2013)
NE Atlantic	V	2015	neuston nets	300µm and 25µm		small MP (25-100µm) 1630000/km ² , LMP: 50000/km ²	>25µm	pieces and lines	PE, PP, PVC, PS, PET	(Poulain et al., 2019)
Aveiro lagoon, Bay of Biscay	IV	2019	glass bottles	1.2µm	18MP/L and 3MP/L		NA	particles, fibres	NA	(Prata et al., 2020)
Hausgarten observatory, Arctic waters	I	2016	water pumps	32µm	0-1287 n/m ³		<200µm	lines, fragments	PA, ethylene-propylene-diene rubber, polyethylene-chlorinated	(Tekman et al., 2020)
Arrabida, Bay of Biscay	IV	2018, 2019	neuston net	335µm	0.45±0.52 items/m ³		>335µm	fragments	PE, PP	(Rodrigues et al., 2020)
Southampton, North Sea	II	2018	glass plate (sea surface microlayer-)	0.45µm		7.5 fibres/m ²	>45µm	fibres	PE, polyvinyl alcohol,	(Stead et al., 2020)

			water surface tension)						cellulos e	
Bergen-Masfjorden, North Sea	II	2014	vessel water intake	200µm	1.9 particles/m ³		NA	fibres	NA	(Nerheim et al., 2020)
North Sea	II	2014	water with Neuston Catamar an	100µm	0.1-245.4 particles/m ³		majority <100µm	NA	PP, acrylat es, polyure thane, varnish	(Lorenz et al., 2019)

n.s. not specified. S.D. Standard deviation.

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