Supplementary information

Influence of environmental and anthropogenic factors on the composition, concentration and spatial distribution of microplastics: a case study of the Bay of Brest (Brittany, France)

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Table S1: Environmental conditions i) prior to sampling activities in winter, spring and autumn in the Bay of Brest. Data are expressed as mean values calculated from daily measures recorded during the 10 days before the day of each collection; and ii) during computational periods (4 runs of 10 days at 2 different periods). Mean river flow was calculated from the Elorn, Aulne and Mignonne rivers.

Environmental matrix	Sampling time	Wind velocity ± SD (m s^{-1})	Mean rainfall ± SD (mm j^{-1})	Mean river flow ± SD (m^3 s^{-1}) (E: Elorn; M: Mignonne; A: Aulne)
Surface water	Spring (April)	0.77 ± 5.24	0.827 ± 1.408	E: 5.54 ± 0.99 M: 1.17 ± 0.27 A: 19.81 ± 3.73
	Autumn (September)	2.32 ± 2.96	0.173 ± 0.399	E: 1.24 ± 0.10 M: 0.27 ± 0.19 A: 2.87 ± 1.20
Sediment	Winter (February)	4.82 ± 7.20	4.761 ± 4.859	E: 20.90 ± 6.13 M: 4.82 ± 1.60 A: 120.06 ± 38.10
	Autumn (October)	2.66 ± 5.82	4.707 ± 4.148	E: 2.31 ± 0.88 M: 0.48 ± 0.21 A: 7.38 ± 1.48

Computational periods	Initial dates of modelling	Wind velocity ± SD (m s^{-1})	Initial tidal coefficient	Mean river flow ± SD (m^3 s^{-1}) (E: Elorn; M: Mignonne; A: Aulne)
February 2013	5 Feb	7.14 ± 3.78	Neap tide (49)	E: 15.5 ± 2.0 M: 3.7 ± 0.8 A: 84.0 ± 7.9
	11 Feb	4.40 ± 2.15	Spring tide (107)	E: 12.4 ± 2.3 M: 2.7 ± 0.8 A: 63.4 ± 17.5
September 2013	20 Sept	2.51 ± 1.29	Spring tide (105)	E: 1.2 ± 0.2 M: 0.2 ± 0.0 A: 2.2 ± 0.5
	25 Sept	4.00 ± 2.54	Neap tide (54)	E: 1.3 ± 0.1 M: 0.2 ± 0.0 A: 2.8 ± 0.5

Table S2: Microplastic concentrations in surface water and sediment samples from the Bay of Brest (- : no MP detected).

Sampling time	Area	Station	Surface water				Sediment			
			Concentration per m³		Concentration per km²		Concentration per kg		Concentration per l	
			MP m⁻³	Mass (mg m⁻³)	MP km⁻²	Mass (g km⁻²)	MP kg⁻¹ DW	Mass (mg kg⁻¹ DW)	MP l⁻¹	Mass (mg l⁻¹)
Winter / Spring (n = 9)	Anthropogenic	A1	0.14	0.05	30,329	12	-	-	-	-
		A2	0.19	0.12	41,994	26	-	-	-	-
		A3	0.05	0.77	10,498	173	-	-	-	-
	Estuary	E1	0.09	0.05	20,997	11	1.44	0.33	1.68	0.39
		E2	-	-	-	-	2.53	0.02	2.16	0.02
		E3	0.05	0.01	12,214	2	-	-	-	-
	Mixed waters	M1	0.43	1.49	95,274	334	0.39	0.16	0.54	0.22
		M2	0.22	0.04	50,08	10	0.65	0.04	1.22	0.07
		M3	0.02	0.01	3,664	2	8.74	0.59	6.67	0.45
							-	-	-	
Autumn (n = 9)	Anthropogenic	A1	0.49	0.45	78,963	72	-	-	-	-
		A2	0.48	0.24	76,829	39	-	-	-	-
		A3	0.47	0.54	74,694	87	2.03	0.23	2.61	0.29
	Estuary	E1	0.17	0.02	27,744	4	-	-	-	-
		E2	0.01	<0.01	1,525	0.1	0.49	no data	0.45	no data
		E3	0.01	<0.01	1,535	0.1	-	-	-	-
	Mixed waters	M1	1.43	2.17	228,352	347	0.78	0.17	0.83	0.18
		M2	0.03	0.01	4,605	1	0.33	0.14	0.42	0.17
		M3	0.02	<0.01	3,049	1	-	-	-	-

Table S3: Proportions of different shapes of collected items in surface water samples collected from different locations in the Bay of Brest. Data are expressed as percentages after visual observation.

Survey	Influence	Station	Fragments (%)	Pellets (%)	Films (%)	Foams (%)	Fibres (%)
Spring (n = 9)	Anthropogenic	A1	54	3	25	12	6
		A2	82	2	9	7	0
		A3	52	6	15	6	22
	Estuary	E1	50	0	31	6	13
		E2	4	0	0	1	95
		E3	18	0	38	26	18
	Mixed waters	M1	69	7	10	10	4
		M2	21	0	1	0	78
		M3	14	0	5	0	82
Autumn (n = 9)	Anthropogenic	A1	62	5	5	22	5
		A2	75	3	6	13	3
		A3	65	2	7	15	12
	Estuary	E1	84	2	2	8	4
		E2	50	0	0	33	17
		E3	50	0	0	0	50
	Mixed waters	M1	69	4	5	16	6
		M2	58	0	8	8	25
		M3	26	0	13	0	61

Table S4: Proportions of different shapes of collected items in sediment samples collected from different locations in the Bay of Brest. Data are expressed as percentages after visual observation.

Survey	Influence	Station	Fragments (%)	Pellets (%)	Films (%)	Foams (%)	Fibres (%)
Winter (n = 9)	Anthropogenic	A1	88	0	6	0	6
		A2	86	0	5	0	10
		A3	86	0	4	0	10
	Estuary	E1	31	0	25	0	44
		E2	39	0	0	0	61
		E3	65	0	12	0	23
	Mixed waters	M1	83	0	9	1	7
		M2	82	0	11	0	8
		M3	53	0	3	0	43
Autumn (n = 9)	Anthropogenic	A1	47	0	16	0	37
		A2	53	0	35	0	12
		A3	90	0	3	0	6
	Estuary	E1	22	0	0	0	78
		E2	29	0	7	0	64
		E3	29	0	14	0	57
	Mixed waters	M1	83	0	0	0	17
		M2	56	0	13	0	31
		M3	11	0	0	0	89

Table S5: Quantity of fibres in surface water samples collected from the Bay of Brest according to colour. Data are expressed as the total number of fibres collected per sample.

Sampling survey	Influence	Station	Blue	Black	Red	White	Green	Violet	Total
Spring (n = 9)	Anthropogenic	A1	4	0	0	0	0	0	4
		A2	0	0	0	0	0	0	0
		A3	1	15	3	1	0	0	20
	Estuary	E1	5	1	1	0	0	0	7
		E2	127	0	9	0	9	21	166
		E3	3	3	0	0	0	0	6
	Mixed waters	M1	7	0	0	0	0	0	7
		M2	60	3	5	0	4	3	75
		M3	59	9	2	1	0	0	71
Autumn (n = 9)	Anthropogenic	A1	8	0	1	0	0	0	9
		A2	1	2	0	0	0	0	3
		A3	12	0	2	0	0	0	14
	Estuary	E1	0	0	2	0	0	0	2
		E2	0	0	1	0	0	0	1
		E3	3	0	0	0	0	0	3
	Mixed waters	M1	13	0	6	0	0	0	19
		M2	3	0	0	0	0	0	3
		M3	10	3	1	0	0	0	14

Table S6: Quantity of fibres found in sediment samples collected from nine locations in the Bay of Brest according to colour. Data are expressed as the total number of fibres collected per sample.

Survey	Influence	Station	Blue	Black	Red	Total
Winter (n = 9)	Anthropogenic	A1	0	0	0	0
		A2	2	0	0	2
		A3	5	5	0	10
	Estuary	E1	1	4	0	5
		E2	7	8	1	16
		E3	3	2	0	5
	Mixed waters	M1	4	0	0	4
		M2	1	1	1	3
		M3	4	1	0	5
Autumn (n = 9)	Anthropogenic	A1	1	5	1	7
		A2	0	2	0	2
		A3	1	1	0	2
	Estuary	E1	5	2	0	7
		E2	2	5	1	8
		E3	2	1	0	3
	Mixed waters	M1	2	3	0	5
		M2	1	50	1	52
		M3	0	5	1	6

Table S7: Microplastic (fibres excluded) concentrations in surface water samples from the Bay of Brest as a function of polymer type and size class. Data are expressed as the number of microplastic (MP) items per m^3.

Survey	Influence	Station	Microplastic concentration (MP m^{-3})						
			Total MP	PE	PP	PS	5-2 mm	2-1 mm	1-0.335 mm
Spring (n = 9)	Anthropogenic	A1	0.14	0.10	0.03	<0.01	0.06	0.05	0.03
		A2	0.19	0.11	0.07	<0.01	0.06	0.04	0.09
		A3	0.05	0.03	0.02	-	0.03	0.02	-
		Mean (± SD)	**0.12 ± 0.07**	**0.08 ± 0.04**	**0.04 ± 0.03**	**<0.01**	**0.05 ± 0.02**	**0.04 ± 0.02**	**0.04 ± 0.04**
	Estuary	E1	0.09	0.08	0.01	-	<0.01	0.04	0.05
		E2	-	-	-	-	-	-	-
		E3	0.05	0.03	0.01	0.01	0.02	0.01	0.03
		Mean (± SD)	**0.05 ± 0.05**	**0.04 ± 0.04**	**0.01 ± 0.01**	**<0.01**	**0.01 ± 0.01**	**0.02 ± 0.02**	**0.03 ± 0.03**
	Mixed waters	M1	0.43	0.33	0.09	<0.01	0.16	0.18	0.08
		M2	0.22	0.15	0.05	0.02	0.07	0.08	0.08
		M3	0.02	0.02	-	-	0.01	<0.01	-
		Mean (± SD)	**0.22 ± 0.20**	**0.17 ± 0.16**	**0.05 ± 0.04**	**0.01 ± 0.01**	**0.08 ± 0.08**	**0.09 ± 0.09**	**0.05 ± 0.05**
	Bay of Brest	*Mean (± SD)*	**0.13 ± 0.13**	**0.10 ± 0.10**	**0.03 ± 0.03**	**0.01 ± 0.01**	**0.05 ± 0.05**	**0.05 ± 0.06**	**0.04 ± 0.04**
Autumn (n = 9)	Anthropogenic	A1	0.49	0.31	0.03	0.15	0.25	0.17	0.07
		A2	0.48	0.32	0.08	0.08	0.13	0.20	0.15
		A3	0.47	0.32	0.05	0.09	0.17	0.14	0.16
		Mean (± SD)	**0.48 ± 0.01**	**0.32 ± 0.00**	**0.06 ± 0.02**	**0.11 ± 0.04**	**0.18 ± 0.06**	**0.17 ± 0.03**	**0.13 ± 0.05**
	Estuary	E1	0.17	0.12	0.03	0.03	0.03	0.08	0.07
		E2	0.01	<0.01	-	<0.01	<0.01	<0.01	-
		E3	0.01	<0.01	<0.01	-	-	<0.01	<0.01
		Mean (± SD)	**0.06 ± 0.09**	**0.04 ± 0.07**	**0.01 ± 0.01**	**0.01 ± 0.01**	**0.01 ± 0.01**	**0.03 ± 0.04**	**0.02 ± 0.04**
	Mix waters	M1	1.43	0.90	0.21	0.32	0.61	0.55	0.27
		M2	0.03	0.02	<0.01	-	0.01	0.01	<0.01
		M3	0.02	0.01	-	<0.01	-	0.03	-
		Mean (± SD)	**0.49 ± 0.81**	**0.31 ± 0.51**	**0.07 ± 0.12**	**0.11 ± 0.18**	**0.21 ± 0.35**	**0.19 ± 0.31**	**0.09 ± 0.15**
	Bay of Brest	*Mean (± SD)*	**0.35 ± 0.46**	**0.22 ± 0.29**	**0.05 ± 0.07**	**0.08 ± 0.11**	**0.13 ± 0.20**	**0.13 ± 0.18**	**0.08 ± 0.09**

Table S8: Microplastic (fibres excluded) concentrations in sediment samples for each location during the two surveys. Data are expressed as the number of microplastic (MP) items per kg DW of sediment.

Survey	Influence	Station	Microplastic concentration (MP kg^{-1} DW)							
			Total MP	PE	PP	PS	5-2 mm	2-1 mm	1-0.335 mm	<0.335 mm
Winter (n = 9)	Anthropogenic	A1	-	-	-	-	-	-	-	-
		A2	-	-	-	-	-	-	-	-
		A3	-	-	-	-	-	-	-	-
		Mean (± SD)	-	-	-	-	-	-	-	-
	Estuary	E1	1.44	0.96	-	0.48	-	0.48	0.96	-
		E2	2.53	-	1.90	0.63	-	-	1.27	1.27
		E3	-	-	-	-	-	-	-	-
		Mean (± SD)	**1.33 ± 1.27**	**0.32 ± 0.56**	**0.63 ± 1.10**	**0.37 ± 0.33**	**-**	**0.16 ± 0.28**	**0.74 ± 0.66**	**0.42 ± 0.73**
	Mixed waters	M1	0.39	-	0.39	-	-	0.39	-	-
		M2	0.65	0.65	-	-	-	0.33	0.33	-
		M3	8.74	5.25	2.62	0.87	-	3.50	4.37	0.87
		Mean (± SD)	**3.26 ± 4.75**	**1.97 ± 2.86**	**1.00 ± 1.42**	**0.29 ± 0.50**	**-**	**1.40 ± 1.81**	**1.57 ± 2.44**	**0.29 ± 0.50**
	Bay of Brest	*Mean (± SD)*	**1.53 ± 2.84**	**0.76 ± 1.72**	**0.55 ± 1.00**	**0.22 ± 0.35**	**-**	**0.52 ± 1.13**	**0.77 ± 1.43**	**0.24 ± 0.48**
Autumn (n = 9)	Anthropogenic	A1	-	-	-	-	-	-	-	-
		A2	-	-	-	-	-	-	-	-
		A3	2.03	0.68	0.68	0.68	-	-	1.35	0.68
		Mean (± SD)	**0.68 ± 1.17**	**0.23 ± 0.39**	**0.23 ± 0.39**	**0.23 ± 0.39**	**-**	**-**	**0.45 ± 0.78**	**0.23 ± 0.39**
	Estuary	E1	-	-	-	-	-	-	-	-
		E2	0.49	0.49	-	-	-	-	-	0.49
		E3	-	-	-	-	-	-	-	-
		Mean (± SD)	**0.16 ± 0.28**	**0.16 ± 0.28**	**-**	**-**	**-**	**-**	**-**	**0.16 ± 0.28**
	Mixed waters	M1	0.78	0.78	-	-	-	-	0.39	0.39
		M2	0.33	0.33	-	-	-	-	-	0.34
		M3	-	-	-	-	-	-	-	-
		Mean (± SD)	**0.37 ± 0.39**	**0.37 ± 0.39**	**-**	**-**	**-**	**-**	**0.13 ± 0.22**	**0.24 ± 0.21**
	Bay of Brest	*Mean (± SD)*	**0.40 ± 0.67**	**0.25 ± 0.32**	**0.08 ± 0.23**	**0.08 ± 0.23**	**-**	**-**	**0.19 ± 0.45**	**0.21 ± 0.27**