Supplementary Materials

Assessment of the sources and inflow processes of microplastics in the river environments of Japan

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Supplementary Notes

Verification of the net change

To determine the differences in the microplastic concentration owing to the change in the net design, microplastics were sampled simultaneously at Noda Bridge over Edo River on 5 September 2016 using two types of nets (i.e., 100-µm and 335-µm nets). The 335-µm net (85 particles) collected more microplastics than the 100-µm net (14 particles), while the water volume filtered by the 335-µm net (59.5 m^3) was greater than that filtered by the 100-µm net (11.1 m^3). Consequently, the numerical concentration collected by the 335-µm net (1.43 particles m^{-3}) was similar to that collected by the 100-µm net (1.26 particles m^{-3}).

Measurement of the water volume filtered by the net

The water volume that passed through the net during sampling (i.e., 'filtered water volume') was measured using a flow metre (No. 5571-A, RIGO Co. Ltd., Japan) installed at the mouth of the net in November 2015. Since the flow metre was not introduced before November 2015, an electromagnetic current metre (AEM1-D; JFE Advantech Co., Ltd., Japan) was used to evaluate the filtered water volume. The flow velocity outside the net ('outside velocity'; v_{out}) was measured with the electromagnetic current metre and then converted into the flow velocity inside the net ('inside velocity'; v_{in}), which is generally lower than v_{out} due to clogging by suspended solids. The linear relationship between v_{in} and v_{out} was obtained by simultaneously measuring them since November 2015 ($v_{in} = 0.163\ v_{out}$; $R^2 = 0.324$, $p = 7.67\times10^{-13} < 0.05$). v_{in} was estimated by substituting v_{out} into the significant linear relationship (Supplementary Fig. S6). Subsequently, the filtered water volume was calculated by multiplying the projected area of the mouth net ($0.25 \times 0.30 \times 0.30 \times \pi = 0.0707$ m^2) by the estimated internal velocity.

Salinity-based density separation using a saturated sodium chloride solution

When large suspended materials were collected, the samples underwent salinity-based density separation using a saturated sodium chloride solution made with tap water (specific gravity ≈ 1.20) based on Hidalgo-Ruz et al. (2012). The samples filtered by the 100-μm net were transferred to 500 ml of the salt solution in a 1-litre glass beaker. The mixture was stirred for 5 min or more using a stirrer (RS-6AR; AS ONE Co. Ltd., Japan) and then allowed to rest for 15 min or more to promote separation. During the stirring process, the beaker was covered with aluminium foil. The lighter materials floated to the surface, while the heavier materials dropped to the bottom of the beaker. The lighter materials were filtered from the supernatant liquid using the 100-µm net. The salinity-based density separation was repeated until no light materials were obtained.

Classification of the water quality monitoring stations

The Basic Environment Law establishes two environmental quality standards (hereinafter, EQSs) for water pollution for the protection of human health and the conservation of the living environment (https://www.env.go.jp/en/water/wq/wp.pdf). Based on the standard values of the five indices related to the conservation of the living environment, that is, hydrogen ion concentration (pH), biochemical oxygen demand (BOD), suspended solids (SS), dissolved oxygen (DO), and total coliforms, the water quality monitoring stations were classified into six water quality classes (Supplementary Table S4). The standard values are defined based on the daily average values of the five indices. The water use in each class is shown in Table S4. Class AA denotes the cleanest water quality station, and this river water is used in the conservation of the natural environment. Class E is the most polluted water quality station.

Comparison of the size distribution of microplastics in Japanese rivers with that in the East Asian seas

Interestingly, the size distribution of microplastics in Japanese rivers is similar to that in the East Asian seas (Isobe et al., 2015) (Fig. S7). The ratios of plastic pieces in both the East Asian seas (Isobe et al., 2015) (white bars in Fig. S7) and Japanese rivers (black bars in Fig. S7) were high for sizes smaller than 1.0 mm. The ratios of plastic pieces smaller than 1.0 mm in the Japanese rivers were higher than those in the East Asian seas. The cumulative ratio of these plastics in rivers (34%) is also greater than that in the oceans (20%). One possible cause of the larger ratio of small plastics in the rivers is that the sampling net became rapidly clogged with massive suspended solids in the rivers but not in the ocean. This clogging effectively reduced the net mesh size to 100 μm or 335 μm (see Material and methods); thus, small plastic was easier to collect. In addition, the size distribution of the microplastics depends on the water densities of the rivers and oceans. The rate of increase of the microplastics with the water density in the oceans is greater than that in the rivers, and thus larger microplastics easily float on the surface, resulting in a higher ratio of large microplastics in the oceans (Isobe et al., 2015). Recently, Sagawa et al. (2018) demonstrated that smaller microplastics more easily sink to the bottom of a coastal sea due to biofouling and soil deposition; therefore, the amount of smaller microplastics at the bottom was significantly more than that at the surface. These reasons could cause the difference in the microplastic size distributions between rivers and oceans.

References

Hidalgo-Ruz, V., Gutow, L., Thompson, R.C., Thiel, M., 2012. Microplastics in the marine environment: a review of the methods used for identification and quantification. Environ. Sci. Technol. 46, 3060-3075.

Isobe, A., Uchida, K., Tokai, T., Iwasaki, S., 2015. East Asian seas: A hot spot of pelagic microplastics. Mar. Pollut. Bull. 101, 618-623.

Sagawa, N., Kawaai, K., Hinata, H., 2018. Abundance and size of microplastics in a coastal sea: Comparison among bottom sediment, beach sediment, and surface water. Mar. Pollutt. Bull. 133, 532-542.

Supplementary Figures and Tables

Figure S1 Pictures of microplastics collected from rivers and the sampling process. (a) A view of sampling the microplastics on a bridge and (b) a plankton net being pulled from a river. Three major polymers were collected: (c) polyethylene, (d) polypropylene, and (e) polystyrene.

Figure S2 Maps of the mean mass concentrations of the three major polymers on all sampling days at each site. Panels (c)–(d) are enlarged maps of the areas shown in squares in panel (a). The number around each circle indicates the survey site number shown in Table 1. The bold and thin lines denote the river streams and prefectural boundaries, respectively. The colours of the circles shows the concentration according to the scale in the bottom-right of panel (a).

Figure S3 Statistics of basin characteristics of each water quality class. (a) basin area, (b) population density, (c) urban ratio, and (d) agricultural ratio. Both the black and white bars indicate the averages of each class, and the colour shows the statistical significance at a 95% confidence level (black: significant, white: nonsignificant). The error bars are the standard deviation of each class. The vertical axis of each panel shows the values of the basin characteristics, with units shown in the upper-right of each panel.

Figure S4 Photographs of microplastics found in sand under roadside trees in the city area (a) and in the tidal flat near the river mouth of the Ara River (b) and plastic litter accumulated on a river wall (c).

Figure S5 Relationship between the microplastic concentrations and the difference in the water level during sampling and the 185-day water level at the water level observation sites near the microplastic sampling sites during the sampling year.

Figure S6 Relationship of the flow velocity inside the net measured with a flowmeter (inside velocity) with that outside measured with an electromagnetic current metre (outside velocity). The regression line was used to estimate the inside velocity when the flowmeter was not installed in the net.

Figure S7 Size distribution of the microplastics collected at all survey sites. The black (white) bars and circles indicate the ratio and cumulative ratio for each size of the plastics collected in the rivers (East Asian seas), respectively. The size distribution in the East Asian seas (white bars and circles) is from Isobe et al. (2015).

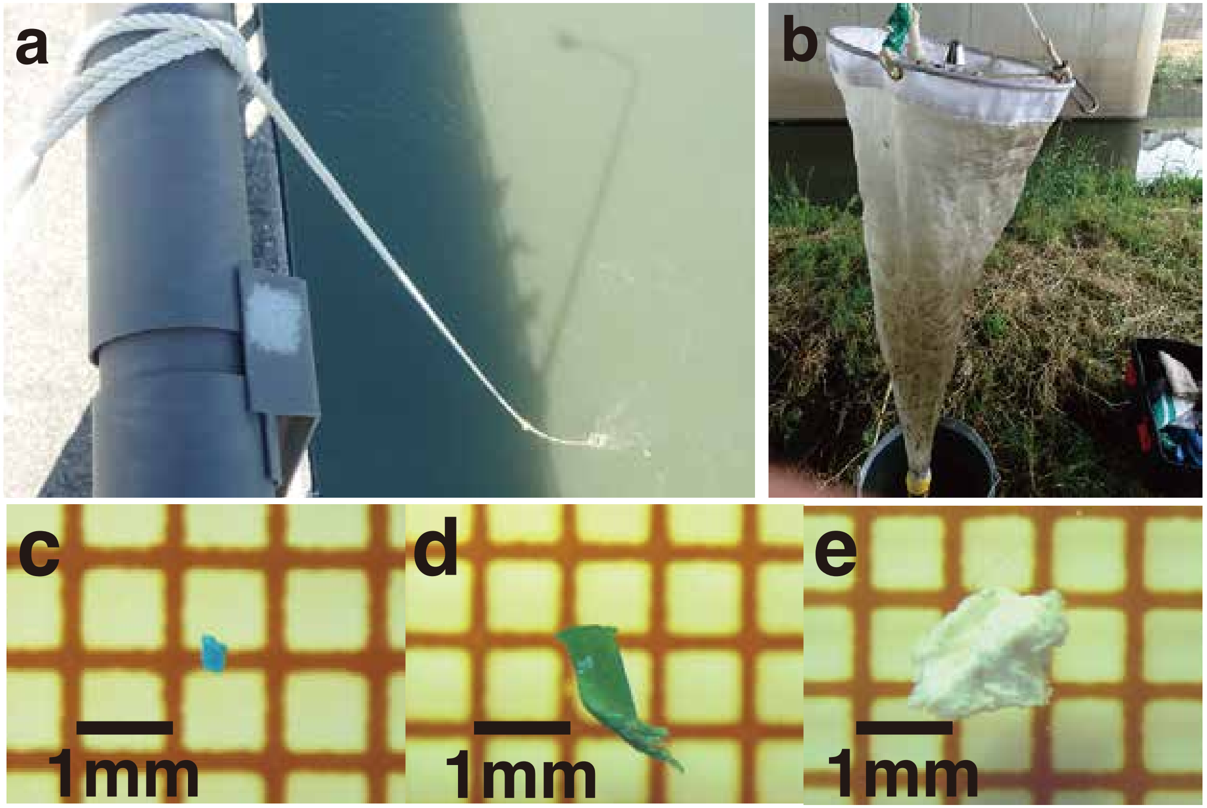
Table S1 Data of microplastic concentration, basin characteristics, and water quality parameters.

Table S2 Mean microplastic concentrations and basin characteristics for each water quality class and results of their statistical analyses.

Table S3 Linear relationship of microplastic concentration with basin characteristics and water quality parameters

Table S4 Standard values for classifying the water quality stations.

Supplementary Video Sampling of microplastics from Noda Bridge over Edo River. The upper edge of the net is kept on the water surface.



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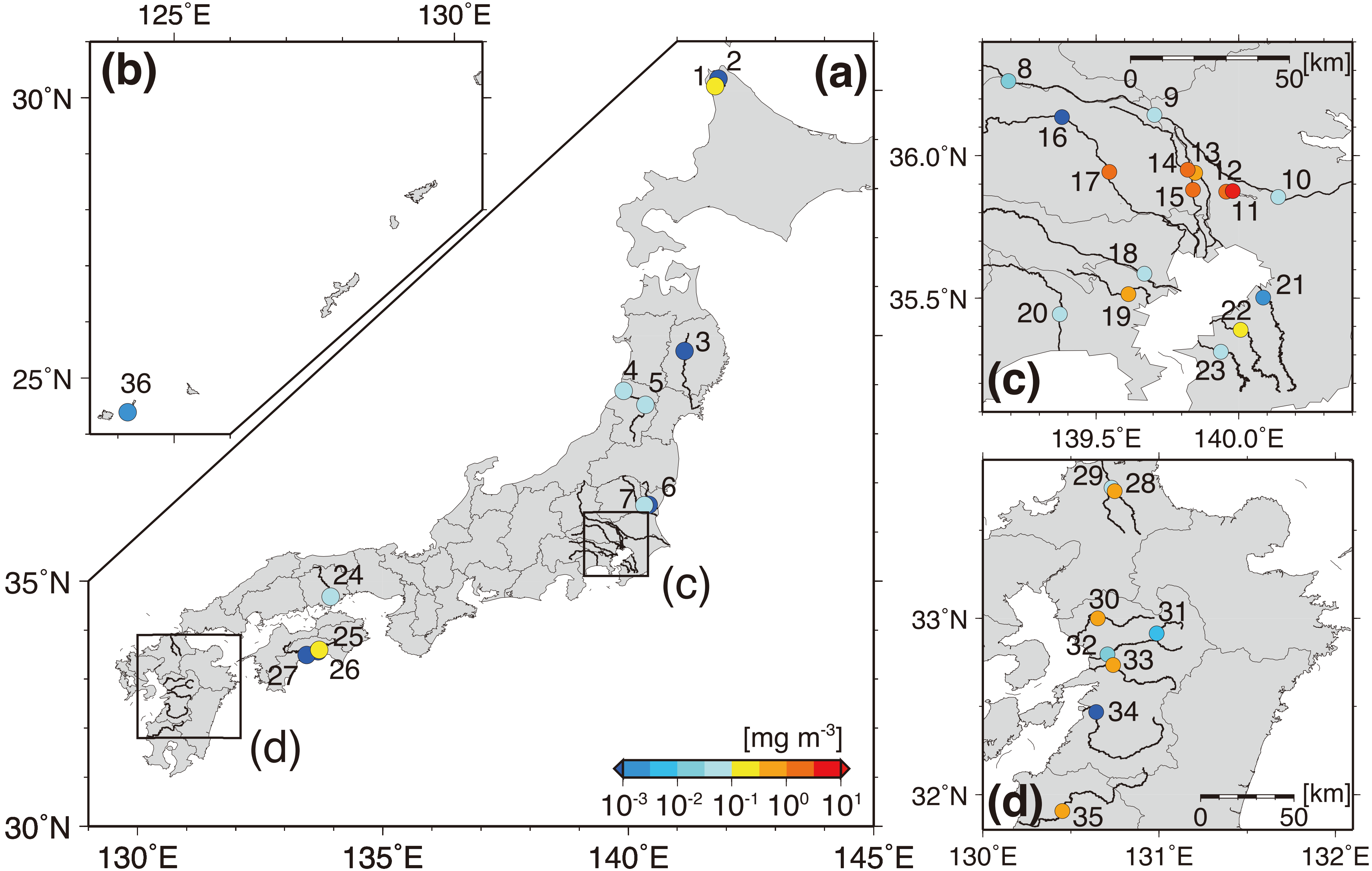

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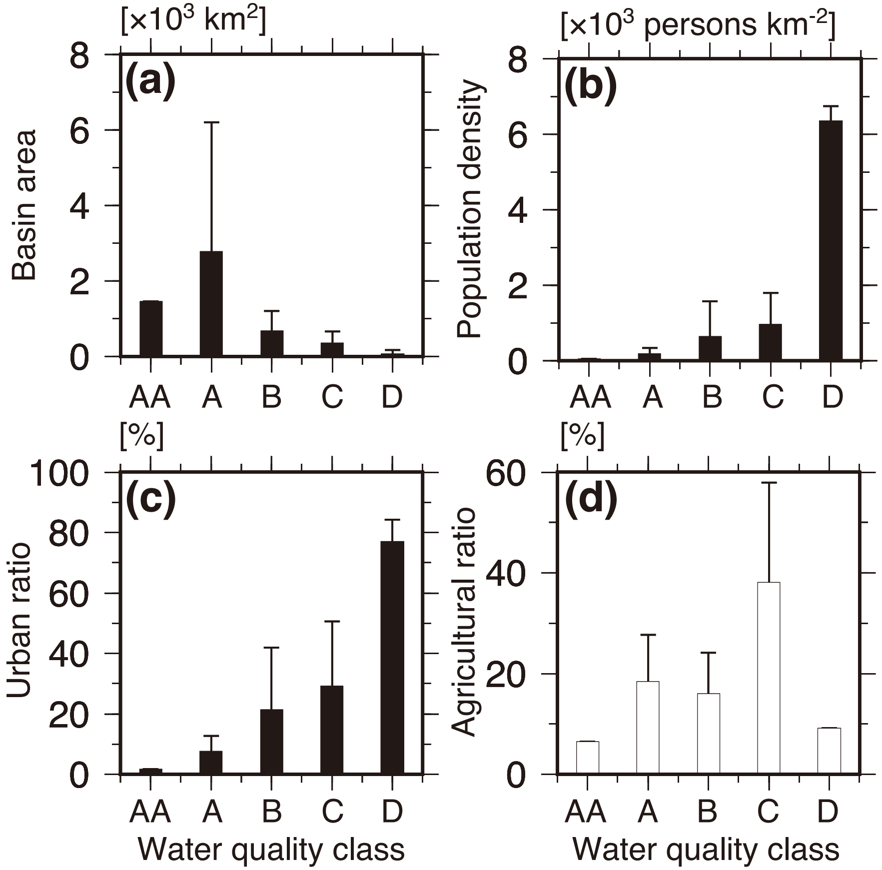

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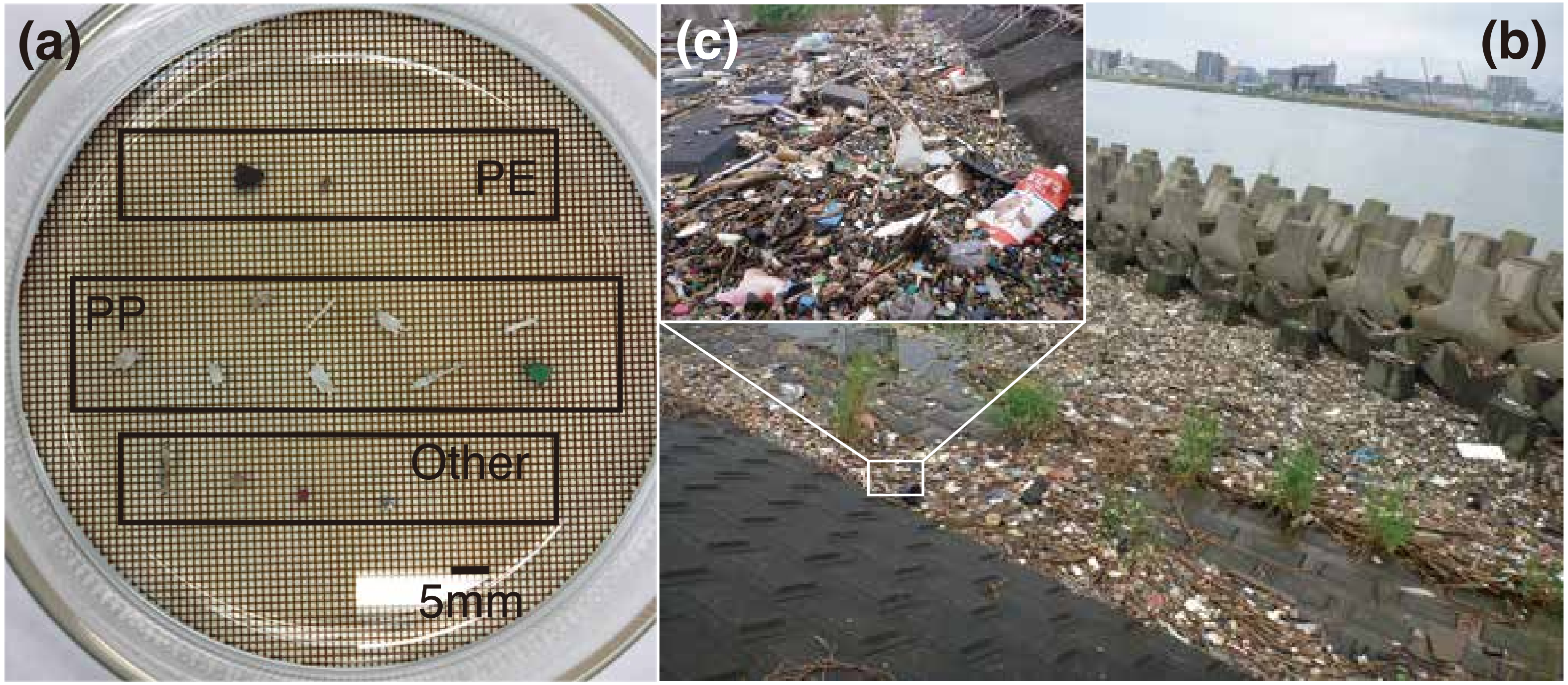

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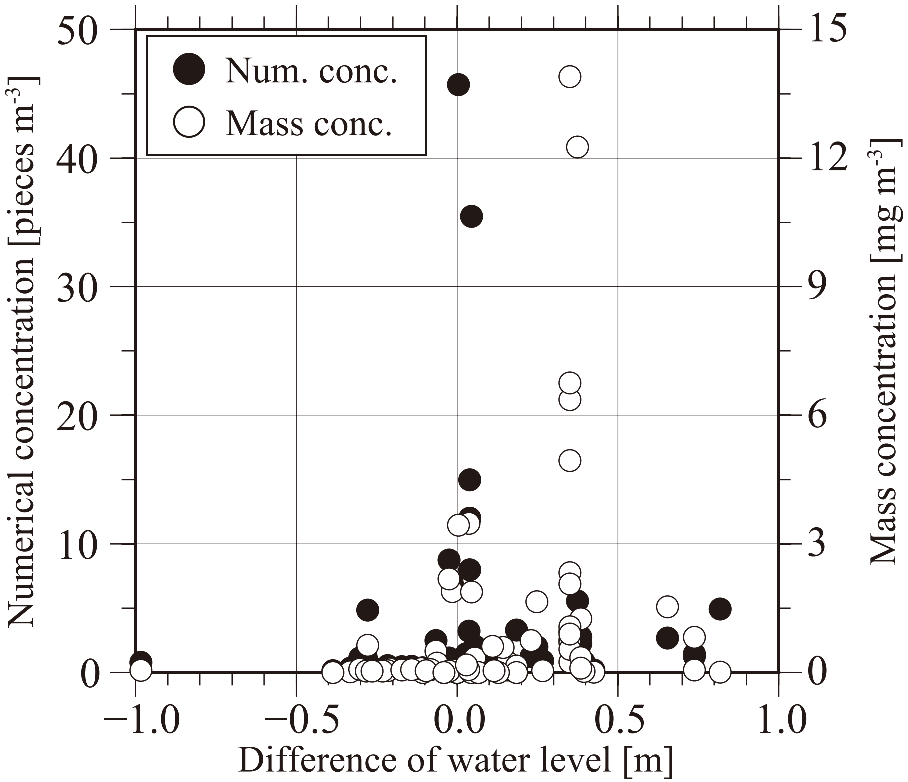
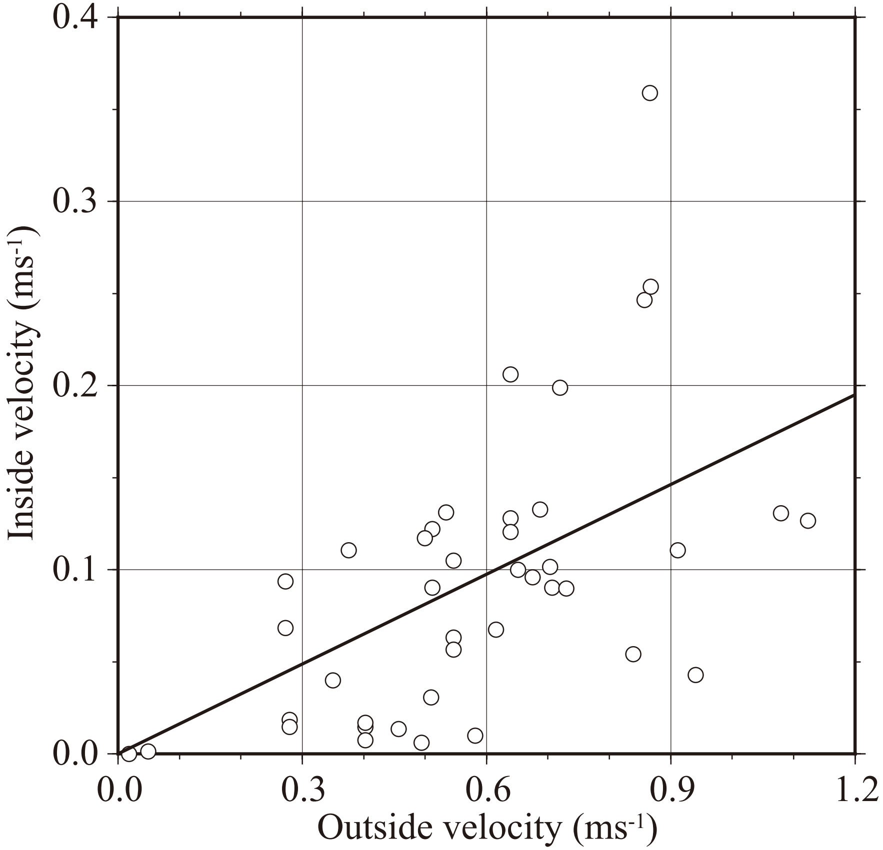


Figure S5 Relationship between the microplastic concentrations and the difference in the water level during sampling and the 185-day water level at the water level observation sites near the microplastic sampling sites during the sampling year.



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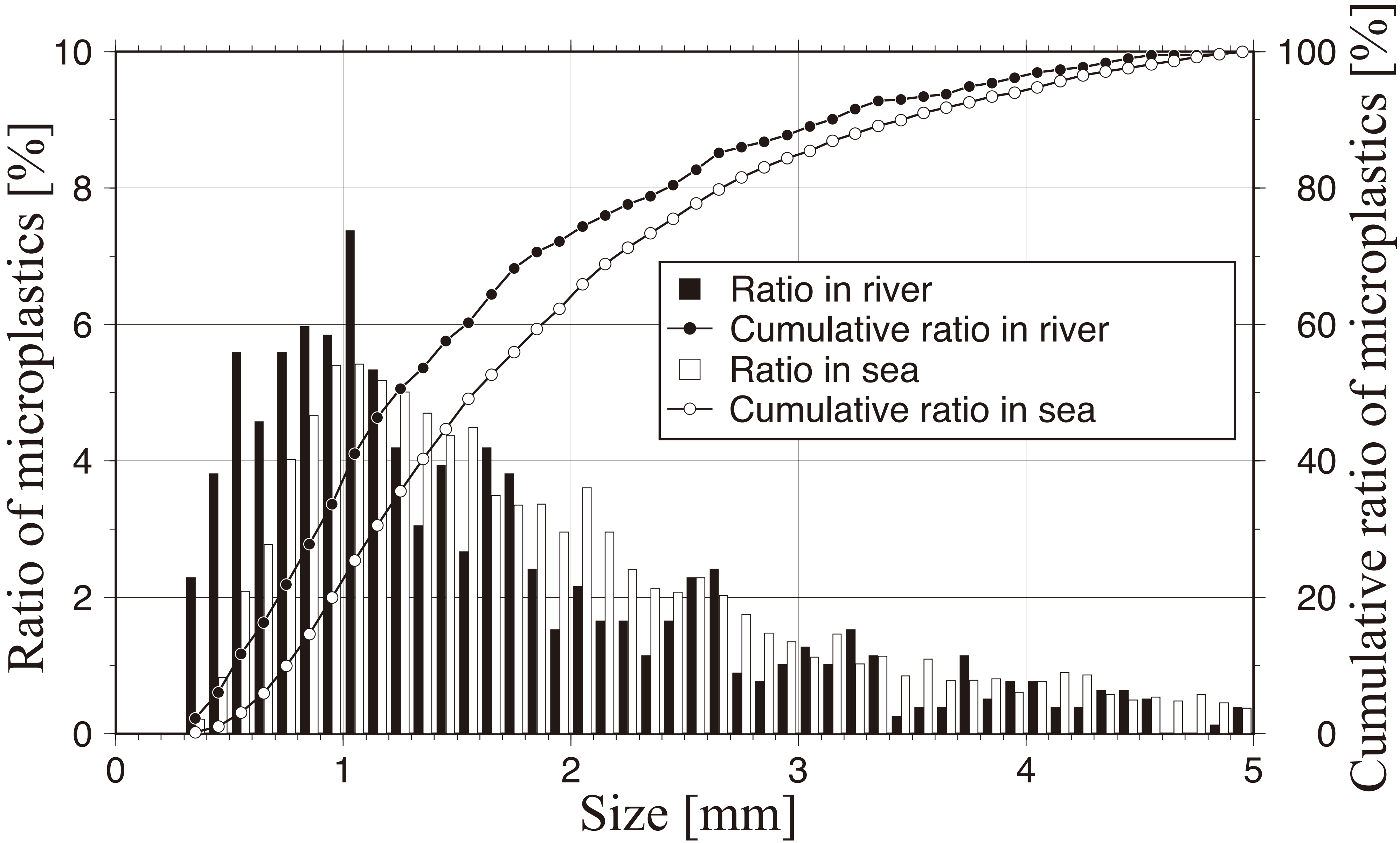

Figure S7 Size distribution of the microplastics collected at all survey sites. The black (white) bars and circles indicate the ratio and cumulative ratio for each size of the plastics collected in the rivers (East Asian seas), respectively. The size distribution in the East Asian seas (white bars and circles) is from Isobe et al. (2015).

Table S1 Data of microplastic concentration, basin characteristics, and water quality parameters

Site No.	Site	River	Date	Microplastics				Basin characteristics				Water quality							
				Num. of candidates [pcs]	Num. of microplastics [pcs]	Num. conc. (mean±S.D.) [pcs m^{-3}]	Mass conc. (mean±S.D.) [mg m^{-3}]	Basin area [km^2]	Population density [persons km^{-2}]	Urban ratio [%]	Agriculture ratio [%]	Water-quality stn.	Class	pH	BOD [mg L^{-1}]	SS [mg L^{-1}]	DO [mg L^{-1}]	T-N [mg L^{-1}]	T-P [mg L^{-1}]
1	Toyotomi	Shimoebekorobetsu R.	2017/10/04	18	2	1.21×10^{0}	1.83×10^{-1}	130	6	1	16	–	–	–	–	–	–	–	–
2	Komatsu	Koetoi R.	2017/10/04	19	0	0.00	0.00	84	4	1	29	Koetoi	–	–	–	–	–	–	–
3	Meiji	Kitakami R.	2017/11/28	8	1	7.22×10^{-2}	7.22×10^{-4}	2221	141	5	17	Minami-oohashi	A	7.47	0.83	6.42	11.28	0.72	0.02
4	Shonai-oohashi	Mogami R.	2015/8/31	9	7	3.60×10^{-1}	8.38×10^{-2}	6537	130	6	17	Sunakoshi	A	6.96	0.72	10.75	10.76	0.81	0.04
5	Kurotaki	Mogami R.	2015/9/1	16	11	5.49×10^{-1}	4.03×10^{-2}	4118	182	8	19	Inashita	A	6.93	1.48	8.50	10.56	1.37	0.06
6	Tomioka	Kuji R.	2016/7/7	4	1	2.95×10^{-2}	7.67×10^{-5}	959	59	3	14	Tomioka	A	7.58	0.69	3.08	10.08	0.73	0.03
7	Nakagawa	Naka R.	2016/7/7	25	15	4.97×10^{-1}	3.29×10^{-2}	2242	145	8	26	Noguchi	A	8.03	0.63	4.50	10.42	1.43	0.04
8	Bando	Tone R.	2017/12/21	23	1	1.71×10^{-1}	3.02×10^{-2}	1920	414	14	18	Bando-oohashi	A	7.40	0.45	7.25	10.76	1.46	0.07
9	Tonegawa	Tone R.	2017/12/21	26	2	1.33×10^{0}	3.94×10^{-2}	8804	329	14	19	Kuri	A	7.59	0.91	9.33	9.70	2.27	0.12
10	Sakae	Tone R.	2016/7/7	12	7	3.65×10^{-1}	7.43×10^{-2}	13019	475	17	25	Fukawa	A	7.65	1.46	15.71	9.05	2.42	0.13
11	Kachi	Ohori R.	2017/05/25, 2017/06/16, 2017/07/13, 2017/08/31, 2017/09/15, 2017/10/19, 2017/11/22	315	96	1.19×10^{1} $\pm1.81\times10^{1}$	1.00×10^{0} $\pm1.32\times10^{0}$	14	6066	82	9	Kitakashiwa	D	7.79	2.43	4.17	8.47	2.91	0.16
12	Kisaki	Ohori R.	2016/12/06, 2017/02/23, 2017/03/23, 2017/04/26, 2017/05/25	200	83	3.87×10^{0} $\pm2.25\times10^{0}$	3.24×10^{0} $\pm5.08\times10^{0}$	23	7161	85	7	Kitakashiwa	D	7.79	2.43	4.17	8.47	2.91	0.16
13	Noda	Edo R.	2015/08/04, 2015/10/13, 2015/11/18, 2016/05/13, 2016/09/05, 2016/12/06, 2017/02/23, 2017/03/23, 2017/04/26, 2017/05/25, 2017/06/16, 2017/07/13, 2017/08/31, 2017/09/15, 2017/10/19, 2017/11/22	954	328	2.77×10^{0} $\pm5.85\times10^{0}$	4.75×10^{-1} $\pm8.50\times10^{-1}$	2248	383	14	19	Noda	A	7.62	0.80	18.61	9.85	2.08	0.11
14	Shinkai	Naka R.	2016/07/27	15	11	2.67×10^{0}	1.53×10^{0}	250	1000	37	52	Yayoi	C	7.45	1.46	18.33	7.58	2.58	0.17
15	Yoshikoshi	Naka R.	2015/08/04, 2015/12/04	37	29	2.18×10^{0} $\pm1.49\times10^{0}$	1.78×10^{0} $\pm2.41\times10^{0}$	697	1784	45	47	Hachijo	C	7.42	2.03	21.54	7.79	3.00	0.18
16	Arakawa	Ara R.	2017/12/21	23	0	0.00	0.00	973	163	7	8	Kuge	B	7.87	1.13	5.42	9.81	1.49	0.06
17	Kaihei	Ara R.	2018/05/26	19	9	2.26×10^{0}	2.57×10^{0}	1637	441	68	15	Kaihei	B	7.79	2.43	4.17	8.47	2.91	0.16
18	Maruko	Tama R.	2015/12/08, 2017/12/12	24	5	2.34×10^{-1} $\pm3.31\times10^{-1}$	3.20×10^{-2} $\pm4.53\times10^{-2}$	1198	2931	31	3	Denenchofu-zeki	B	7.72	1.43	3.84	8.88	4.79	0.31
19	Shinyokohama	Tsurumi R.	2015/12/08	21	8	4.85×10^{0}	6.35×10^{-1}	136	6619	72	9	Kamenoko	D	7.50	3.14	3.92	8.15	6.82	0.39

Table S1 Data of microplastic concentration, basin characteristics, and water quality parameters (continued)

Site No.	Site	River	Date	Microplastics: Num. of candidates [pcs]	Num. of microplastics [pcs]	Num. conc. (mean±S.D.) [pcs m^{-3}]	Mass conc. (mean±S.D.) [mg m^{-3}]	Basin characteristics: Basin area [km^2]	Population density [persons km^{-2}]	Urban ratio [%]	Agriculture ratio [%]	Water quality: Water-quality stn.	Class	pH	BOD [mg L^{-1}]	SS [mg L^{-1}]	DO [mg L^{-1}]	T-N [mg L^{-1}]	T-P [mg L^{-1}]
20	Sagami-oohashi	Sagami R.	2016/07/27	9	7	2.66×10^{-1}	4.31×10^{-2}	1522	446	12	6	Sagami-oohashi	A	7.90	0.77	5.67	10.37	1.25	0.05
21	Kasumi	Yoro R.	2015/11/18	5	1	7.11×10^{-1}	3.06×10^{-3}	251	208	10	22	Asai	B	8.07	1.53	12.00	9.45	0.95	0.12
22	Nakagawa	Obitsu R.	2015/11/18	13	6	3.29×10^{0}	1.55×10^{-1}	227	110	6	18	Tsubaki	B	7.95	1.18	8.50	9.23	1.15	0.11
23	Rokusan	Koito R.	2015/11/18	35	11	7.89×10^{-1}	4.94×10^{-2}	107	116	5	15	Yachiyo	C	8.05	1.03	7.00	8.50	0.99	0.17
24	Okakita-oohashi	Asahi R.	2015/09/17	21	14	9.00×10^{-1}	4.37×10^{-2}	1625	70	4	13	Otoide-zeki	A	7.59	0.77	2.61	9.58	0.55	0.02
25	Matchida	Mononobe R.	2017/09/28	11	3	1.48×10^{0}	1.77×10^{-1}	461	21	1	4	Toitajima	A	8.00	0.54	2.75	10.58	–	–
26	Mononobe	Mononobe R.	2017/09/28	5	0	0.00	0.00	465	26	1	5	Fukabuchi	A	8.02	0.53	2.04	10.48	0.34	0.01
27	Niyodo-oohashi	Niyodo R.	2017/12/20	20	0	0.00	0.00	1451	43	2	7	Nakajima	AA	7.50	0.52	1.75	9.78	0.33	0.01
28	Kanroku	Onga R.	2017/06/29	36	11	8.65×10^{-1}	6.96×10^{-2}	383	508	19	17	Hinode	B	7.87	1.10	6.08	9.33	1.20	0.08
29	Okamori	Hikosan R.	2017/06/29	50	6	4.27×10^{-1}	6.09×10^{-1}	307	406	17	15	Nakajima	B	8.03	1.55	6.50	9.85	1.25	0.08
30	Yamagaseibu-oohashi	Kikuchi R.	2016/09/12	57	17	1.25×10^{0}	7.44×10^{-1}	743	181	11	32	Yamaga	A	7.60	0.50	3.00	8.90	1.80	0.08
31	Kurumagaeri	Kuro R.	2015/11/19	9	2	2.10×10^{-1}	6.35×10^{-3}	186	125	9	33	Muta	A	7.45	1.16	22.10	8.93	1.03	0.09
32	Yotsugi	Shira R.	2016/09/12	50	38	4.94×10^{0}	1.05×10^{-2}	455	334	12	30	Yotsugi	B	8.11	0.93	39.83	9.70	1.02	0.09
33	Medomachi	Midori R.	2016/09/12	14	1	2.06×10^{0}	3.36×10^{-1}	705	67	5	18	Jonan	A	7.75	0.70	7.00	9.67	0.79	0.03
34	Seibu-oohashi	Kuma R.	2016/09/12	11	0	0.00	0.00	1882	50	3	9	Yokoishi	A	7.53	0.50	2.25	9.98	0.58	0.03
35	Miyanojo	Sendai R.	2016/09/12	154	69	9.35×10^{-1}	5.83×10^{-1}	1032	68	6	19	Tsuruta-dam	A	7.23	1.24	5.70	8.18	1.04	0.12
36	Kawara	Miyara R.	2015/10/22	10	2	3.23×10^{-1}	2.86×10^{-3}	23	11	2	35	Yamada	A	7.43	0.70	6.67	7.02	–	–

Table S2 Mean microplastic concentrations and basin characteristics for each water quality class and results of their statistical analyses

	Contents	Mean ± SD					Bartlett test			Kruskal-Wallis test		
		AA*1	A	B	C	D	Free-dom*2	χ^2 value	P value	Free-dom*2	χ^2 value	P value
Micro-plastics	**Numerical conc.**	**0.0**	**0.64 ± 0.71**	**1.6 ± 1.8**	**1.9 ± 1.0**	**8.4 ± 5.0**	**3**	**19.9**	**1.8×10^{-4}**	**3**	**10.5**	**1.5×10^{-2}**
	Mass conc.	**0.0**	**0.13 ± 0.22**	**0.43 ± 0.89**	**1.1 ± 0.94**	**0.82 ± 0.26**	**3**	**25.9**	**9.9×10^{-6}**	**3**	**9.6**	**2.2×10^{-2}**
Basin characteristics	**Basin area**	**1451**	**2778 ± 3413**	**679 ± 526**	**351 ± 308**	**75 ± 86**	**3**	**33.2**	**2.9×10^{-7}**	**3**	**13.5**	**3.7×10^{-3}**
	Population density	**43**	**181 ± 157**	**638 ± 937**	**967 ± 835**	**6343 ± 391**	**3**	**31.8**	**5.8×10^{-7}**	**3**	**13.8**	**3.2×10^{-3}**
	Urban ratio	**2**	**8 ± 5**	**21 ± 21**	**29 ± 21**	**77 ± 7**	**3**	**23.1**	**3.8×10^{-5}**	**3**	**14.2**	**2.7×10^{-3}**
	Agriculture ratio	7	18 ± 9	16 ± 8	38 ± 20	9 ± 0	3	9.2	2.7×10^{-2}	3	6.1	1.1×10^{-1}

*1The standard deviation is not calculated because of one water quality station of class AA.

*2Mean concentration data of class AA was excluded in the two statistical analyses because of only one water quality station (see Supplementary Table S1).

*3Bold charecter means a content with statistically significant difference of its average.

Table S3 Linear relationship of microplastic concentration with basin characteristics and water quality parameters

	Contents	Numerical concentration					Mass concentration				
		Slope	Intercept	R^2	Num.	P-value	Slope	Intercept	R^2	Num.	P-value
Basin characteristics	Basin area	-1.7×10^{-1}	1.8×10^{0}	0.04	36	2.4×10^{-1}	-5.1×10^{-2}	4.9×10^{-1}	0.03	36	2.9×10^{-1}
	Population density	**8.3×10^{-1}**	**7.7×10^{-1}**	**0.47**	**36**	**4.2×10^{-6}**	**2.3×10^{-1}**	**2.0×10^{-1}**	**0.32**	**36**	**3.2×10^{-4}**
	Urban ratio	**6.7×10^{-2}**	**3.0×10^{-1}**	**0.49**	**36**	**2.0×10^{-6}**	**2.6×10^{-2}**	**-5.4×10^{-2}**	**0.64**	**36**	**4.7×10^{-9}**
	Agriculture ratio	-2.5×10^{-3}	1.5×10^{0}	0.00	36	9.4×10^{-1}	1.0×10^{-2}	2.2×10^{-1}	0.02	36	3.8×10^{-1}
Water quality	pH	1.3×10^{0}	-8.2×10^{0}	0.03	34	3.5×10^{-1}	-1.2×10^{-2}	5.2×10^{-1}	0.00	34	9.8×10^{-1}
	BOD	**2.0×10^{0}**	**-8.0×10^{-1}**	**0.34**	**34**	**3.1×10^{-4}**	**7.6×10^{-1}**	**-4.7×10^{-1}**	**0.43**	**34**	**2.6×10^{-5}**
	SS	5.4×10^{-2}	1.1×10^{0}	0.03	34	3.0×10^{-1}	7.3×10^{-4}	4.2×10^{-1}	0.00	34	9.7×10^{-1}
	DO	**-8.1×10^{-1}**	**9.1×10^{0}**	**0.13**	**34**	**3.8×10^{-2}**	**-3.8×10^{-1}**	**4.0×10^{0}**	**0.25**	**34**	**2.5×10^{-3}**
	T-N	**7.4×10^{-1}**	**3.1×10^{-1}**	**0.18**	**32**	**1.5×10^{-2}**	**2.5×10^{-1}**	**2.3×10^{-2}**	**0.18**	**32**	**1.6×10^{-2}**
	T-P	**1.1×10^{1}**	**4.2×10^{-1}**	**0.16**	**32**	**2.4×10^{-2}**	**3.4×10^{0}**	**9.4×10^{-2}**	**0.13**	**32**	**4.4×10^{-2}**

Table S4 Standard values for classifying water quality stations

Class	Standard value					Water Use
	Hydrogen-ion concentration (pH)	Biochemical oxygen demand (BOD)	Suspended solids (SS) [mg/L]	Dissolved oxygen (DO) [mg/L]	Total coliform [MPN/100mL]	
AA	$6.5 \leq pH < 8.5$	≤ 1.0	≤ 25.0	≥ 7.5	≤ 50	Natural conservation*1, Water supply class 1*2, and uses listed in A-E
A	$6.5 \leq pH < 8.5$	≤ 2.0	≤ 25.0	≥ 7.5	$\leq 1,000$	Water supply class 2*3, fishery class 1*5, bathing, and uses listed in B-E
B	$6.5 \leq pH < 8.5$	≤ 3.0	≤ 25.0	≥ 5.0	$\leq 5,000$	Water supply class 3*4, fishery class 2*6, and uses listed in C-E
C	$6.5 \leq pH < 8.5$	≤ 5.0	≤ 50.0	≥ 5.0	-	Fishery class 3*7, industrial water class 1*8 and uses listed in D-E
D	$6.5 \leq pH < 8.5$	≤ 8.0	≤ 100.0	≥ 2.0	-	Industrial water class 2*9, agricultural water, and uses listed in E
E	$6.5 \leq pH < 8.5$	≤ 10.0	No floating debris	≥ 2.0	-	Industrial water class 3*10, and environmental conservation*11

*1 Nature conservation: Conservation of sightseeing and other environments

*2 Water supply class 1: Purify water using filters and other simple means

*3 Water supply class 2: Purify water using sedimentation filters and other ordinary means

*4 Water supply class 3: Purify water using pre-treatment and other advanced methods

*5 Fishery class 1: For such oligosaprobic members, and marine products for fishery class 2 and 3

*6 Fishery class 2: For such alpha-oligosaprobic marine products, and marine products for fishery class 3

*7 Fishery class 3: For such beta-oligosaprobic marine products

*8 Industrial water class 1: Purify water using sedimentation and other oridinary means

*9 Industrial water class 2: Purify water using chemical additives and other advanced means

*10 Industrial water class 3: Purify water using special means

*11 Environmental conservation: Limit of not disrupting the day-to-day lives of the population