

Supplementary information

For

Novel brominated flame retardants relevant for European aquatic environments: ranking of analytes to monitor and focus on the French Eastern Mediterranean coastline.

Camille Rigal ¹, Laurence Asia ¹, Stéphanie Lebarillier ¹, Pierre Doumenq ¹, Pascal Mirleau ², Laure Malleret ^{1*}

¹ *Laboratoire Chimie Environnement, Aix Marseille Univ, CNRS, Europole de l'Arbois, Aix-en-Provence, France*

² *IMBE – Aix Marseille Univ, Avignon Université, CNRS, IRD, Marseille, France*

* *Corresponding author : laure.malleret@univ-amu.fr*

Environmental Science and Pollution Research

Table of contents

Table of contents.....	1
Figure S1 : Picture of a suspended matter trap.....	2
Table S1 : Information about the ten collected samples of suspended matter : geographical coordinates, depth, exposure periods, fraction sieved and total organic carbon (TOC).....	2
Table S2 : GC/EI-MS/MS (MRM mode) methods for the analysis of CPs and PCBs with a 7890A GC coupled to Triple quadrupole 3000 A MS (Agilent Technologies, Santa Clara, USA) ; EI, 70 eV.....	3
Table S3 : Transitions used for quantification and qualification of PCBs and CPs.....	3
Table S4 : Limits of detection (LODs) and quantification (LOQs) of compounds analysed in this study.....	4
Table S5 : OSPAR Background Assessment Concentrations (BAC) and Environmental Assessment Concentrations (EAC) for PCBs in sediments.....	6
Table S6 : Federal Environmental Quality Guidelines (FEQGs) established for PBDEs in sediments by the Canadian Environmental Protection Act, 1999.....	6
Table S7 : Ranking of the 148 reported nBFRs based on European production or import, occurrence and ecotoxicology.....	7
Table S8 : Chemical and physical properties of the 22 nBFRs targeted : molecular weight (MW), log Kow (computed by XLogP3 3.0, PubChem), water solubility (predicted with ECOSAR), ebullition temperature (predicted with ACD/Labs Percepta Platform - PhysChem Module, version: 14.00) and score at the relevance ranking.....	19
Table S9 : Concentrations of 38 halogenated flame retardants targeted in the suspended matter samples.....	20
Table S10 : Non-parametric Spearman rank correlation across the detected compounds.....	22
Table S11 : Risk quotients obtained for the detected nBFRs.....	23

Figure S1 : Picture of a suspended matter trap



Table S1 : Information about the ten collected samples of suspended matter : geographical coordinates, depth, exposure periods, fraction sieved and total organic carbon (TOC)

Sampling Site	Latitude (minutes)	Longitude (minutes)	Depth (m)	Sampling date	Collecting period ¹ (days)	Fraction sieved ² (μm)	COT	Mass analysed (g d.w.)
FOS	43° 25.268'N	4° 56.478'E	7	24/04/2018	154	< 500	1.0%	10.620
NIO	43° 20.260'N	5° 15.360'E	16	20/02/2018	85	< 500	1.8%	4.896
VEY	43° 12.392'N	5° 15.178'E	27	08/03/2018	100	< 500	3.7%	2.905
EST	43° 21.285'N	5° 17.352'E	13	17/04/2018	56	< 250	5.0%	1.177
MAI	43° 12.768'N	5° 19.842'E	17	26/02/2018	90	< 250	3.2%	8.300
SAM	43° 13.409'N	5° 20.648'E	16	13/02/2018	132	< 500	4.2%	10.018
CHE	43° 12.250'N	5° 21.970'E	10	08/03/2018	108	< 500	5.2%	1.449
SMN	43° 5.117'N	5° 56.413'E	11	20/04/2018	135	< 500	4.7%	2.185
SMH	43° 4.488'N	5° 57.198'E	12	20/11/2018	125	< 500	5.6%	4.903
PRA	43° 5.867'N	6° 0.772'E	11	20/04/2018	123	< 500	8.5%	1.900

¹ The overall monitoring of posidonia meadows and sample collection involves three diving periods each year, leading to 90-130 days sampling intervals for a given site (depending on meteorological conditions, divers and boats availabilities). However, suspended matter traps may be found detached or overturned on the bottom sediment (probably due to net-fishing activities); in that case, suspended matter samples are not recovered, traps are cleaned, placed back to their initial position and further sampled (e.g. the Estaque trap was repaired 20/02/2018 and the SM sample collected 17/04/2018, making the shortest collecting period of 56 days).

² Suspended matter samples were initially used to assess trace metals (TM) concentrations and a sieving protocol was developed to compare concentrations obtained in various sieving fractions (similar TM concentrations were obtained in the various sieving fractions). Only fractions < 250 μm of the sampling dates remained in sufficient amount for Estaque and Maïre samples. As required to detect and quantify trace organic contaminants, the sieving protocol was further adjusted to the single fraction < 500 μm , yielding higher suspended matter sample mass.

Table S2 : GC/EI-MS/MS (MRM mode) methods for the analysis of CPs and PCBs with a 7890A GC coupled to Triple quadrupole 3000 A MS (Agilent Technologies, Santa Clara, USA) ; EI, 70 eV

CPs	
Injector temperature (°C)	280°C
Transfer line temperature (°C)	250°C
Source temperature (°C)	250°C
Oven programm	120°C (hold 1 minute) Heat 15°C/min until 300°C (hold 7 minutes)
PCBs	
Injector temperature (°C)	300°C
Transfer line temperature (°C)	300°C
Source temperature (°C)	280°C
Oven programm	60°C (hold 1 minute) Heat 20°C/min until 120°C Heat 6°C/min until 250°C Heat 17.5°C/min until 300°C (hold 2 minutes)

Table S3 : Transitions used for quantification and qualification of PCBs and CPs

	Quantifier	Collision energy (V)	Qualifier	Collision energy (V)
PCB 30 d5	261 -> 191	15	263 -> 191	15
PCB 28	256 -> 186	15	258 -> 188	15
PCB 52	290 -> 220	20	292 -> 222	15
PCB 101	326 -> 256	20	328 -> 256	20
PCB 116 d5	331 -> 261	20	331 -> 259	20
PCB 118	326 -> 256	20	324 -> 254	20
PCB 153	360 -> 290	20	360 -> 288	20
PCB 138	360 -> 290	20	360 -> 288	20
PCB 156 d3	363 -> 293	20	363 -> 291	20
PCB 180	394 -> 324	20	396 -> 361	20
CPs	101 -> 65	8	115 -> 78 102 -> 78	8 10
¹³ C ₆ -HCB	290 -> 220	20	292 -> 222	20

Table S4 : Limits of detection (LODs) and quantification (LOQs) of compounds analysed in this study

	FOS	NIO	VEY	EST	MAI	SAM	CHE	SMN	SMH	PRA	Mean
Sample mass (g d.w.)	10.620	4.896	2.905	1.177	8.300	10.018	1.449	2.185	4.903	1.900	4.032
nBFRs (LOD / LOQ in ng.g ⁻¹ d.w.)											
2,4-DBP	0.04 / 0.13	0.08 / 0.27	0.14 / 0.46	0.34 / 1.14	0.05 / 0.16	0.04 / 0.13	0.28 / 0.92	0.18 / 0.61	0.08 / 0.27	0.21 / 0.70	0.14 / 0.48
2,4,6-TBP	0.02 / 0.07	0.05 / 0.15	0.08 / 0.25	0.19 / 0.63	0.03 / 0.09	0.02 / 0.07	0.15 / 0.51	0.10 / 0.34	0.05 / 0.15	0.12 / 0.39	0.08 / 0.27
BEH-TEBP	0.68 / 2.26	1.47 / 4.90	2.48 / 8.26	6.12 / 20.39	0.87 / 2.89	0.72 / 2.40	4.97 / 16.56	3.30 / 10.98	1.47 / 4.89	3.79 / 12.63	2.59 / 8.62
BTBPE	0.09 / 0.29	0.19 / 0.63	0.32 / 1.06	0.79 / 2.62	0.11 / 0.37	0.09 / 0.31	0.64 / 2.13	0.42 / 1.41	0.19 / 0.63	0.49 / 1.62	0.33 / 1.11
DBDPE	1.72 / 5.72	3.72 / 12.41	6.28 / 20.92	15.49 / 51.64	2.20 / 7.32	1.82 / 6.07	12.58 / 41.95	8.35 / 27.82	3.72 / 12.40	9.60 / 31.99	6.55 / 21.82
DBE-DBCH	0.05 / 0.17	0.11 / 0.38	0.19 / 0.63	0.47 / 1.57	0.07 / 0.22	0.06 / 0.18	0.38 / 1.27	0.25 / 0.84	0.11 / 0.38	0.29 / 0.97	0.20 / 0.66
DBHCTD	0.03 / 0.09	0.06 / 0.19	0.10 / 0.32	0.23 / 0.78	0.03 / 0.11	0.03 / 0.09	0.19 / 0.64	0.13 / 0.42	0.06 / 0.19	0.15 / 0.48	0.10 / 0.33
EH-TBB	0.12 / 0.39	0.25 / 0.84	0.42 / 1.41	1.05 / 3.48	0.15 / 0.49	0.12 / 0.41	0.85 / 2.83	0.56 / 1.88	0.25 / 0.84	0.65 / 2.16	0.44 / 1.47
HBB	0.02 / 0.06	0.04 / 0.14	0.07 / 0.23	0.17 / 0.58	0.02 / 0.08	0.02 / 0.07	0.14 / 0.47	0.09 / 0.31	0.04 / 0.14	0.11 / 0.36	0.07 / 0.24
PBB-Acr	0.03 / 0.10	0.06 / 0.21	0.10 / 0.35	0.26 / 0.86	0.04 / 0.12	0.03 / 0.10	0.21 / 0.70	0.14 / 0.46	0.06 / 0.21	0.16 / 0.53	0.11 / 0.36
PBBB	0.02 / 0.08	0.05 / 0.18	0.09 / 0.30	0.22 / 0.73	0.03 / 0.10	0.03 / 0.09	0.18 / 0.60	0.12 / 0.40	0.05 / 0.18	0.14 / 0.45	0.09 / 0.31
PBBz	0.02 / 0.05	0.03 / 0.11	0.06 / 0.19	0.14 / 0.47	0.02 / 0.07	0.02 / 0.05	0.11 / 0.38	0.08 / 0.25	0.03 / 0.11	0.09 / 0.29	0.06 / 0.20
PBEB	0.01 / 0.05	0.03 / 0.10	0.05 / 0.17	0.13 / 0.43	0.02 / 0.06	0.02 / 0.05	0.10 / 0.35	0.07 / 0.23	0.03 / 0.10	0.08 / 0.27	0.05 / 0.18
PBP	1.48 / 4.94	3.22 / 10.72	5.42 / 18.07	13.38 / 44.60	1.90 / 6.33	1.57 / 5.24	10.87 / 36.23	7.21 / 24.03	3.21 / 10.71	8.29 / 27.63	5.66 / 18.85
PBT	0.01 / 0.04	0.03 / 0.10	0.05 / 0.16	0.12 / 0.40	0.02 / 0.06	0.01 / 0.05	0.10 / 0.33	0.06 / 0.22	0.03 / 0.10	0.07 / 0.25	0.05 / 0.17
TBBPA	0.59 / 1.98	1.29 / 4.30	2.17 / 7.25	5.37 / 17.89	0.76 / 2.54	0.63 / 2.10	4.36 / 15.53	2.89 / 9.64	1.29 / 4.29	3.32 / 11.08	2.27 / 7.56
TBBPA-BDBPE	1.00 / 3.34	2.17 / 7.24	3.66 / 12.20	9.03 / 30.11	1.28 / 4.27	1.06 / 3.54	7.34 / 24.46	4.87 / 16.22	2.17 / 7.23	5.60 / 18.65	3.82 / 12.73
TBBPS-BME	0.10 / 0.34	0.22 / 0.75	0.38 / 1.26	0.93 / 3.10	0.13 / 0.44	0.11 / 0.36	0.76 / 2.52	0.50 / 1.67	0.22 / 0.74	0.58 / 1.92	0.39 / 1.31
TBP-AE	0.01 / 0.05	0.03 / 0.10	0.05 / 0.17	0.13 / 0.43	0.02 / 0.06	0.02 / 0.05	0.11 / 0.35	0.07 / 0.23	0.03 / 0.10	0.08 / 0.27	0.05 / 0.18
TBX	0.01 / 0.03	0.02 / 0.06	0.03 / 0.10	0.08 / 0.25	0.01 / 0.04	0.01 / 0.03	0.06 / 0.21	0.04 / 0.14	0.02 / 0.06	0.05 / 0.16	0.03 / 0.11
TDBP-TAZTO	0.35 / 1.15	0.75 / 2.50	1.26 / 4.22	3.12 / 10.40	0.44 / 1.48	0.37 / 1.22	2.54 / 8.45	1.68 / 5.60	0.75 / 2.50	1.93 / 6.44	1.32 / 4.40
TTBP-TAZ	0.99 / 3.31	2.15 / 7.18	3.63 / 12.10	8.96 / 29.86	1.27 / 4.23	1.05 / 3.51	7.28 / 24.26	4.83 / 16.09	2.15 / 7.17	5.55 / 18.50	3.79 / 12.62

Table S4 (continued) : Limits of detection (LODs) and quantification (LOQs) of compounds analysed in this study

	FOS	NIO	VEY	EST	MAI	SAM	CHE	SMN	SMH	PRA	Mean
Sample mass (g d.w.)	10.620	4.896	2.905	1.177	0.264	10.018	1.449	2.185	4.903	1.900	4.032
PBDEs (LOD / LOQ in ng.g ⁻¹ d.w.)											
BDE 28	0.02 / 0.07	0.04 / 0.15	0.08 / 0.25	0.19 / 0.62	0.03 / 0.09	0.02 / 0.07	0.15 / 0.50	0.10 / 0.33	0.04 / 0.15	0.12 / 0.38	0.05 / 0.15
BDE 47	0.01 / 0.04	0.03 / 0.09	0.05 / 0.15	0.11 / 0.38	0.02 / 0.05	0.01 / 0.04	0.09 / 0.31	0.06 / / 0.20	0.03 / 0.09	0.07 / 0.23	0.03 / 0.09
BDE 99	0.01 / 0.05	0.03 / 0.10	0.05 / 0.17	0.13 / 0.43	0.02 / 0.06	0.02 / 0.05	0.10 / 0.35	0.07 / 0.23	0.03 / 0.10	0.08 / 0.27	0.03 / 0.10
BDE 100	0.02 / 0.06	0.04 / 0.13	0.07 / 0.22	0.17 / 0.55	0.02 / 0.08	0.02 / 0.06	0.13 / 0.45	0.09 / 0.30	0.04 / 0.13	0.10 / 0.34	0.04 / 0.13
BDE 153	0.02 / 0.06	0.04 / 0.14	0.07 / 0.23	0.17 / 0.58	0.02 / 0.08	0.02 / 0.07	0.14 / 0.47	0.09 / 0.31	0.04 / 0.14	0.11 / 0.36	0.04 / 0.14
BDE 154	0.03 / 0.11	0.07 / 0.25	0.12 / 0.41	0.31 / 1.02	0.04 / 0.14	0.04 / 0.12	0.25 / 0.83	0.16 / 0.55	0.07 / 0.24	0.19 / 0.63	0.07 / 0.25
BDE 183	0.07 / 0.24	0.16 / 0.53	0.27 / 0.89	0.66 / 2.20	0.09 / 0.31	0.08 / 0.26	0.54 / 1.79	0.36 / 1.19	0.16 / 0.53	0.41 / 1.36	0.16 / 0.54
BDE 209	4.56 / 15.21	9.90 / 32.99	16.68 / 55.61	41.17 / 137.25	5.84 / 19.46	4.84 / 16.12	33.44 / 111.48	22.18 / 73.93	9.88 / 32.95	25.51 / 85.02	10.02 / 33.41
PCBs (LOD / LOQ in ng.g ⁻¹ d.w.)											
PCB 28	0.002 / 0.008	0.005 / 0.017	0.008 / 0.028	0.020 / 0.020	0.003 / 0.010	0.002 / 0.008	0.017 / 0.057	0.011 / 0.038	0.005 / 0.017	0.013 / 0.043	0.005 / 0.017
PCB 52	0.003 / 0.009	0.006 / 0.020	0.010 / 0.034	0.025 / 0.085	0.004 / 0.012	0.003 / 0.010	0.021 / 0.069	0.014 / 0.046	0.006 / 0.020	0.016 / 0.053	0.006 / 0.021
PCB 101	0.003 / 0.010	0.007 / 0.022	0.011 / 0.037	0.027 / 0.092	0.004 / 0.013	0.003 / 0.011	0.022 / 0.075	0.015 / 0.049	0.007 / 0.022	0.017 / 0.057	0.007 / 0.022
PCB 118	0.005 / 0.018	0.011 / 0.038	0.019 / 0.065	0.048 / 0.160	0.007 / 0.023	0.006 / 0.019	0.039 / 0.130	0.026 / 0.086	0.011 / 0.038	0.029 / 0.099	0.012 / 0.039
PCB 138	0.005 / 0.018	0.011 / 0.038	0.019 / 0.065	0.048 / 0.160	0.007 / 0.023	0.006 / 0.019	0.039 / 0.130	0.026 / 0.086	0.011 / 0.038	0.029 / 0.099	0.012 / 0.039
PCB 153	0.006 / 0.019	0.013 / 0.042	0.021 / 0.070	0.053 / 0.173	0.007 / 0.025	0.006 / 0.020	0.043 / 0.141	0.028 / 0.093	0.013 / 0.042	0.033 / 0.107	0.013 / 0.042
PCB 180	0.004 / 0.012	0.008 / 0.026	0.013 / 0.043	0.032 / 0.107	0.005 / 0.015	0.004 / 0.013	0.026 / 0.087	0.017 / 0.058	0.008 / 0.026	0.020 / 0.066	0.008 / 0.026
CPs (LOD / LOQ in ng.g ⁻¹ d.w.)											
CPs	10.6 / 35.3	22.9 / 76.5	38.7 / 128.9	95.5 / 318.2	13.5 / 45.1	11.2 / 37.4	77.5 / 258.5	51.4 / 171.4	22.9 / 76.4	59.1 / 197.1	23.2 / 77.5

Table S5 : [OSPAR](#) Background Assessment Concentrations (BAC) and Environmental Assessment Concentrations (EAC) for PCBs in sediments

Congener	BAC ($\mu\text{g.kg}^{-1}\text{d.w.}$) ¹	EAC ($\mu\text{g.kg}^{-1}\text{d.w.}$) ¹
PCB 28	0.22	1.7
PCB 52	0.12	2.7
PCB 101	0.14	3.0
PCB 118	0.17	0.6
PCB 138	0.15	7.9
PCB 153	0.19	40
PCB 180	0.10	12

¹ Values normalized to 1% TOC.

Table S6 : Federal Environmental Quality Guidelines (FEQGs) established for PBDEs in sediments by the [Canadian Environmental Protection Act, 1999](#)

Homologue ¹	Congeners	Sediment ² ($\text{ng.g}^{-1}\text{d.w.}$)
triBDE	total	44
tetraBDE	total	39
pentaBDE	total	0.4
pentaBDE	BDE-99	0.4
pentaBDE	BDE-100	0.4
hexaBDE	total	440
heptaBDE	total	-
octaBDE	total	5600 ³
nonaBDE	total	-
decaBDE	total	19 ^{3,4}

¹ FEQG for triBDE (tribromodiphenyl ether), tetraBDE (tetrabromodiphenyl ether), hexaBDE (hexabromodiphenyl ether), heptaBDE (heptabromodiphenyl ether), nonaBDE (nonabromodiphenyl ether) and decaBDE (decabromodiphenyl ether) are based on data for the congeners: BDE-28, BDE-47, BDE-153, BDE-183, BDE-206, and BDE-209, respectively unless otherwise noted.

² Values normalized to 1% organic carbon.

³ Values adopted from Ecological Screening Assessment Report (Environment Canada 2006). Sediment guidelines for octaBDE and decaBDE were adapted from the SAR by being corrected for the sediment organic carbon in the actual tests, then normalised to 1% organic carbon instead of the 4% in the SAR.

⁴ Values based on commercial decaBDE mixture which is composed mainly of nonaBDE and decaBDE.

Table S7 : Ranking of the 148 reported nBFRs based on European production or import, occurrence and ecotoxicology

Identity	A - Registration / Production		B - Occurrence			C - Ecotoxicology		Score for relevance ranking			
	CAS Number (Acronym) ₁	US EPA ²	ECHA (ton/year)	nBFR analyzed (number of studies)	nBFR detected (number of studies)	%	LC ₅₀ on fish. 96h (µg/L)	Trophic Magnification Factor ₃	A	B	C
79-94-7 (TBBPA)	Yes	≥ 10 000 – < 100 000	16 [1] [2] [3] [4] [5] [6] [7] [8] [9] [10] [11] [12] [13] [14] [15] [16]	15 [1] [2] [3] [4] [5] [7] [8] [9] [10] [11] [12] [13] [14] [15] [16]	94%	9.5	-	4	3	2	9
21850-44-2 (TBBPA-BDBPE)	Yes	≥ 1 000 – < 10 000	6 [7] [9] [16] [17] [18] [19]	4 [7] [16] [17] [18]	67%	2.20E-03	-	3	3	3	9
84852-53-9 (DBDPE)	Yes	≥ 10 000 – < 100 000	88 [1] [8] [12] [13] [14] [18] [19] [20] [21] [22] [23] [24] [25] [26] [27] [28] [29] [30] [31] [32] [33] [34] [35] [36] [37] [38] [39] [40] [41] [42] [43] [44] [45] [46] [47] [48] [49] [50] [51] [52] [53] [54] [55] [56] [57] [58] [59] [60] [61] [62] [63] [64] [65] [66] [67] [68] [69] [70] [71] [72] [73] [74] [75] [76] [77] [78] [79] [80] [81] [82] [83] [84] [85] [86] [87] [88] [89] [90] [91] [92] [93] [94] [95] [96] [97] [98] [99] [100]	71 [1] [8] [12] [13] [14] [18] [20] [21] [22] [23] [24] [28] [29] [30] [31] [32] [33] [34] [35] [36] [38] [39] [40] [41] [42] [44] [46] [47] [48] [49] [50] [51] [52] [53] [54] [55] [56] [58] [59] [60] [61] [62] [63] [64] [65] [66] [68] [69] [70] [71] [72] [73] [74] [76] [77] [79] [80] [81] [83] [84] [85] [88] [89] [93] [94] [96] [97] [98] [99] [100]	81%	2.80E-05	0.47 (95% CI : 0.32–0.66)	4	3	2	9

Table S7 (continued) : Ranking of the 148 reported nBFRs based on European production or import, occurrence and ecotoxicology

Identity	A - Registration / Production		B - Occurrence			C - Ecotoxicology		Score for relevance ranking			
	CAS Number (Acronym) 1	US EPA ²	ECHA (ton/year)	nBFR analyzed (number of studies)	nBFR detected (number of studies)	%	LC ₅₀ on fish. 96h (µg/L)	Trophic Magnification Factor ³	A	B	C
26040-51-7 (BEH-TEBP)	Yes	≥ 100 – < 1 000	44 [1] [4] [6] [12] [13] [18] [21] [22] [23] [25] [26] [31] [32] [34] [39] [41] [43] [45] [49] [54] [60] [62] [68] [75] [78] [82] [85] [87] [89] [90] [91] [92] [95] [96] [99] [101] [102] [103] [104] [105] [106] [107] [108] [109]	26 [1] [12] [13] [18] [21] [22] [23] [26] [31] [34] [45] [62] [68] [82] [85] [89] [90] [91] [92] [96] [99] [102] [104] [105] [106] [107]	59%	6.70E-04	-	2	3	3	8
37853-59-1 (BTBPE)	Yes	≥ 1 - < 10	80 [1] [4] [6] [7] [8] [12] [13] [15] [18] [19] [20] [21] [22] [23] [25] [26] [31] [33] [34] [35] [39] [40] [41] [42] [43] [44] [45] [46] [47] [48] [49] [50] [51] [52] [53] [54] [57] [58] [60] [62] [63] [64] [65] [67] [68] [69] [70] [71] [75] [77] [78] [79] [80] [82] [85] [87] [88] [89] [90] [91] [92] [94] [96] [99] [100] [101] [102] [103] [104] [106] [107] [108] [109] [110] [111] [112] [113] [114]	61 [1] [4] [7] [8] [12] [13] [15] [18] [19] [21] [22] [23] [26] [31] [33] [34] [35] [40] [41] [42] [43] [44] [45] [46] [47] [48] [49] [50] [51] [52] [53] [57] [62] [63] [65] [67] [68] [69] [70] [71] [77] [78] [79] [80] [82] [88] [89] [90] [94] [96] [97] [98] [99] [100] [104] [107] [109] [110] [112] [113] [114]	76%	0.22	2.3 (95% CI : 1.5–3.5)	0	3	4	7
59447-55-1 (PBB-Acr)	Yes	≥ 100 – < 1 000	15 [4] [25] [26] [54] [67] [79] [82] [90] [91] [96] [98] [99] [108] [109] [110]	6 [4] [67] [91] [96] [98] [110]	40%	19.0	2.0 (95% CI : 1.5–2.8)	2	2	3	7

Table S7 (continued) : Ranking of the 148 reported nBFRs based on European production or import, occurrence and ecotoxicology

Identity	A - Registration / Production		B - Occurrence			C - Ecotoxicology		Score for relevance ranking			
	CAS Number (Acronym) ₁	US EPA ²	ECHA (ton/year)	nBFR analyzed (number of studies)	nBFR detected (number of studies)	%	LC ₅₀ on fish. 96h (µg/L)	Trophic Magnification Factor ³	A	B	C
52434-90-9 (TDBP-TAZTO)	Yes	≥ 100 – < 1 000	6 [7] [24] [25] [26] [99] [115]	3 [7] [24] [115]	50%	8.90	-	2	3	2	7
87-82-1 (HBB)	Yes	≥ 1 - < 10	81 [1] [4] [6] [7] [14] [15] [18] [20] [21] [22] [23] [24] [25] [26] [27] [31] [32] [33] [34] [35] [36] [37] [38] [39] [40] [44] [46] [47] [49] [51] [53] [54] [55] [56] [57] [58] [59] [60] [62] [63] [65] [67] [70] [75] [76] [77] [78] [79] [81] [82] [84] [85] [86] [87] [88] [89] [90] [91] [92] [93] [94] [95] [97] [98] [99] [100] [101] [103] [104] [105] [106] [107] [108] [109] [110] [112] [113] [116] [117] [118]	59 [4] [7] [15] [18] [20] [21] [22] [24] [25] [26] [31] [32] [33] [34] [35] [39] [40] [44] [46] [47] [49] [51] [53] [55] [57] [62] [63] [65] [67] [70] [72] [75] [77] [79] [81] [82] [84] [85] [87] [88] [89] [90] [91] [92] [93] [94] [95] [97] [98] [99] [103] [104] [107] [110] [112] [113] [116] [117] [118]	73%	7.4	2.9 (95% CI: 1.9–4.5)	0	3	3	6
87-83-2 (PBT)	Yes	≥ 1 - < 10	57 [4] [7] [11] [15] [18] [21] [22] [23] [24] [25] [26] [32] [33] [34] [39] [40] [44] [46] [47] [51] [53] [54] [60] [63] [65] [67] [70] [75] [76] [77] [79] [82] [85] [87] [89] [90] [91] [94] [95] [97] [98] [99] [100] [103] [105] [106] [107] [108] [109] [111] [113] [114] [116] [117] [118] [119] [120]	39 [4] [7] [18] [21] [22] [26] [32] [33] [34] [39] [40] [46] [47] [51] [53] [54] [63] [65] [70] [77] [79] [85] [90] [91] [94] [95] [97] [98] [100] [105] [107] [108] [111] [113] [116] [117] [118]	68%	13	4.5 (95% CI: 3.1–6.3)	0	3	3	6

Table S7 (continued) : Ranking of the 148 reported nBFRs based on European production or import, occurrence and ecotoxicology

Identity	A - Registration / Production		B - Occurrence			C - Ecotoxicology		Score for relevance ranking			
	CAS Number (Acronym) ¹	US EPA ₂	ECHA (ton/year)	nBFR analyzed (number of studies)	nBFR detected (number of studies)	%	LC ₅₀ on fish, 96h (µg/L)	Trophic Magnification Factor ₃	A	B	C
85-22-3 (PBEB)	Yes	≥ 1 - < 10	<p>80</p> <p>[1] [4] [7] [11] [14] [15] [18] [21] [22] [23] [24] [25] [26] [27] [31] [32] [33] [34] [36] [37] [38] [39] [40] [44] [46] [47] [49] [51] [53] [54] [55] [56] [57] [59] [60] [61] [62] [63] [64] [65] [67] [70] [72] [75] [76] [77] [78] [79] [81] [82] [84] [85] [86] [87] [88] [89] [90] [91] [92] [93] [94] [95] [97] [98] [99] [100] [101] [103] [104] [105] [106] [107] [108] [109] [111] [113] [114] [116] [117] [118]</p>	<p>50</p> <p>[1] [7] [14] [18] [21] [22] [25] [26] [31] [32] [33] [34] [40] [46] [47] [49] [53] [54] [55] [57] [62] [63] [70] [72] [75] [77] [78] [79] [81] [85] [87] [88] [89] [90] [91] [93] [94] [95] [97] [98] [100] [104] [105] [106] [107] [108] [109] [111] [113] [118]</p>	63%	4.9	4.0 (95% CI: 2.1–7.6)	0	3	3	6
183658-27-7 (EH-TBB)	Yes	< 1	<p>53</p> <p>[1] [4] [6] [7] [12] [13] [18] [21] [22] [23] [24] [25] [26] [32] [33] [34] [39] [41] [43] [44] [45] [49] [51] [53] [54] [58] [60] [62] [67] [68] [75] [78] [82] [85] [87] [89] [90] [91] [92] [99] [100] [101] [102] [103] [104] [106] [107] [108] [109] [111] [112] [114] [117]</p>	<p>33</p> <p>[7] [12] [13] [18] [21] [22] [23] [25] [26] [33] [34] [39] [41] [43] [44] [45] [49] [51] [53] [62] [67] [68] [82] [91] [92] [99] [100] [104] [107] [108] [111] [112] [117]</p>	62%	0.39	-	0	3	3	6
608-90-2 (PBBz)	Yes	< 1	<p>25</p> <p>[7] [20] [21] [25] [26] [39] [53] [62] [67] [76] [82] [90] [91] [92] [94] [98] [99] [103] [104] [106] [107] [109] [110] [111] [118]</p>	<p>15</p> <p>[7] [20] [21] [26] [53] [62] [91] [94] [98] [99] [104] [107] [110] [111] [118]</p>	60%	40	1.7 (95% CI : 1.4–2.1)	0	3	3	6

Table S7 (continued) : Ranking of the 148 reported nBFRs based on European production or import, occurrence and ecotoxicology

Identity	A - Registration / Production		B - Occurrence			C - Ecotoxicology		Score for relevance ranking			
	CAS Number (Acronym) ¹	US EPA ₂	ECHA (ton/year)	nBFR analyzed (number of studies)	nBFR detected (number of studies)	%	LC ₅₀ on fish. 96h (µg/L)	Trophic Magnification Factor ₃	A	B	C
51936-55-1 (DBHCTD)	Yes	≥ 1 - < 10	25 [4] [11] [13] [22] [23] [25] [26] [31] [47] [54] [60] [67] [75] [76] [79] [82] [89] [90] [98] [99] [101] [102] [106] [108] [117]	8 [13] [22] [31] [47] [79] [90] [98] [108]	33%	0.48	3.9 (95% CI: 3.1–5.0)	0	2	4	6
35109-60-5 (TBP-DPTE)	Yes	≥ 1 - < 10	32 [21] [25] [26] [32] [33] [39] [41] [44] [47] [49] [51] [54] [58] [60] [75] [76] [87] [89] [91] [94] [98] [99] [100] [103] [105] [106] [107] [108] [109] [110] [111] [116]	20 [21] [25] [26] [32] [33] [41] [44] [47] [49] [51] [91] [94] [98] [100] [103] [105] [106] [107] [108] [110]	63%	55	2.8 (95% CI : 1.9–4.0)	0	3	3	6
25713-60-4 ⁴ (TTBP-TAZ)	Yes	≥ 1 - < 10	1 [24]	1 [24]	100%	0.0028	-	2	1	3	6
32588-76-4 (EHTEBPI)	Yes	≥ 100 – < 1 000	-	-	-	0.078	-	2	1	3	6
34571-16-9 (HCTBPH)	Yes	≥ 1 - < 10	29 [11] [20] [21] [25] [27] [31] [36] [37] [38] [49] [53] [55] [56] [58] [59] [62] [67] [72] [82] [85] [86] [90] [92] [93] [95] [105] [106] [107] [111]	11 [31] [37] [38] [53] [58] [62] [82] [85] [92] [93] [111]	38%	0.0052	-	0	2	3	5
39569-21-6 (TBCT)	Yes	≥ 1 - < 10	17 [4] [7] [25] [26] [54] [67] [79] [82] [90] [91] [92] [96] [99] [108] [109] [110] [118]	10 [7] [54] [79] [82] [90] [92] [96] [108] [110] [118]	59%	20	-	0	3	2	5
118-79-6 (2.4.6-TBP)	Yes	≥ 100 – < 1 000	10 [1] [2] [3] [4] [5] [6] [18] [24] [25] [121]	8 [1] [2] [3] [4] [5] [18] [24] [121]	80%	1420	-	2	3	0	5

Table S7 (continued) : Ranking of the 148 reported nBFRs based on European production or import, occurrence and ecotoxicology

Identity	A - Registration / Production		B - Occurrence			C - Ecotoxicology		Score for relevance ranking			
	CAS Number (Acronym) ¹	US EPA ₂	ECHA (ton/year)	nBFR analyzed (number of studies)	nBFR detected (number of studies)	%	LC ₅₀ on fish. 96h (µg/L)	Trophic Magnification Factor ³	A	B	C
3322-93-8 (DBE-DBCH)	Yes	≥ 1 - < 10	26 [1] [4] [18] [19] [20] [21] [22] [23] [25] [26] [39] [54] [76] [79] [82] [90] [96] [98] [99] [101] [108] [110] [113] [114] [122] [123]	13 [18] [21] [22] [23] [26] [54] [79] [90] [96] [98] [110] [122] [123]	50%	434	β-TBECH : 2.6 (95% CI : 1.9–3.5) α-TBECH : 1.9 (95% : 1.5–2.5)	0	3	2	5
3072-84-2 (TBBPA-BGE)	No	≥ 100 – < 1 000	1 [9]	0	0%	7.50	-	2	1	2	5
23488-38-2 (TBX)	Yes	≥ 1 - < 10	26 [4] [7] [11] [20] [25] [26] [40] [46] [54] [62] [67] [76] [77] [79] [82] [83] [90] [91] [98] [99] [107] [108] [109] [117] [118] [119]	20 [4] [7] [26] [40] [54] [62] [77] [79] [82] [83] [90] [91] [98] [99] [107] [108] [109] [117] [118] [119]	77%	23	0.97 (95% CI : 0.82–1.2)	0	3	1	4
3278-89-5 (TBP-AE)	Yes	≥ 1 - < 10	19 [4] [21] [25] [26] [39] [49] [54] [67] [79] [82] [90] [91] [96] [98] [99] [105] [107] [108] [109]	9 [21] [26] [49] [54] [67] [90] [96] [98] [107]	47%	182	1.8 (95% : 1.3–2.6)	0	2	2	4
608-71-9 (PBP)	Yes	≥ 1 - < 10	6 [2] [3] [4] [5] [18] [108]	3 [2] [3] [18]	50%	111	-	0	3	1	4

Table S7 (continued) : Ranking of the 148 reported nBFRs based on European production or import, occurrence and ecotoxicology

Identity	A - Registration / Production		B - Occurrence			C - Ecotoxicology		Score for relevance ranking			
	CAS Number (Acronym) ¹	US EPA ₂	ECHA (ton/year)	nBFR analyzed (number of studies)	nBFR detected (number of studies)	%	LC ₅₀ on fish. 96h (µg/L)	Trophic Magnification Factor ³	A	B	C
58965-66-5 (4'-PeBPOBDE208)	Yes	≥ 1 - < 10	2 [58] [120]	0	0%	4.8E-08	-	0	1	3	4
1084889-51-9 1025956-65-3 893843-07 (OBTMPI)	Yes	< 1	16 [4] [7] [11] [44] [47] [54] [76] [85] [89] [91] [95] [98] [106] [108] [109] [118]	5 [7] [47] [89] [98] [118]	31%	0.000089	0.44 (95% CI : 0.32–0.60)	0	2	2	4
3194-57-8 (TBCO)	Yes	< 1	11 [4] [25] [26] [49] [76] [82] [90] [98] [99] [108] [110]	4 [25] [26] [98] [110]	36%	434	α-TBCO : 2.5 (95% CI : 1.9–3.2) β-TBCO : 2.5 (95% CI : 1.9–3.2)	0	2	2	4
19186-97-1 ⁴ (TTBNPP)	Yes	< 1	2 [4] [45]	2 [4] [45]	100%	3.10	-	1	1	2	4
25327-89-3 (TBBPA-BAE)	No	≥ 1 - < 10	4 [9] [16] [17] [19]	3 [16] [17] [19]	75%	0.032	-	0	1	3	4
37853-61-5 (TBBPA-BME)	Yes	< 1	3 [7] [9] [10]	2 [7] [10]	67%	0.98	-	0	1	3	4
42757-55-1 (TBBPS-BDBPE)	Yes	≥ 1 - < 10	3 [9] [16] [124]	2 [16] [124]	67%	0.48	-	0	1	3	4
66710-97-2 (TBBPA-BHEEBA)	No	≥ 1 - < 10	-	-	-	0.26	-	0	1	3	4
106-93-4	Yes	≥ 1 000 - < 10 000	-	-	-	1.51E+05	-	3	1	0	4
125904-11-2	Yes	≥ 1 000 - < 10 000	-	-	-	3500	-	3	1	0	4
49690-63-3	Yes	≥ 1 - < 10	-	-	-	0.039	-	0	1	3	4
497107-13-8	Yes	< 1	-	-	-	0.00038	-	0	1	3	4
61262-53-1	Yes	≥ 1 - < 10	-	-	-	0.0002	-	0	1	3	4
82001-21-6	Yes	≥ 1 - < 10	-	-	-	1.3E-08	-	0	1	3	4
90075-91-5	Yes	< 1	-	-	-	0.000016	-	0	1	3	4

Table S7 (continued) : Ranking of the 148 reported nBFRs based on European production or import, occurrence and ecotoxicology

Identity	A - Registration / Production		B - Occurrence			C - Ecotoxicology		Score for relevance ranking			
	CAS Number (Acronym) ¹	US EPA ²	ECHA (ton/year)	nBFR analyzed (number of studies)	nBFR detected (number of studies)	%	LC ₅₀ on fish. 96h (µg/L)	Trophic Magnification Factor ³	A	B	C
39635-79-5 (TBBPS)	Yes	≥ 1 - < 10	3 [9] [12] [19]	1 [19]	33%	373	-	0	2	1	3
3555-11-1 (PBP-AE)	Yes	< 1	2 [4] [54]	0	0%	6.5	-	0	1	2	3
3296-90-0 ⁴ (DBNPG)	Yes	≥ 1 - < 10	1 [4]	0	0%	2.32E+06	-	2	1	0	3
4162-45-2 (TBBPA-BHEE)	Yes	≥ 1 - < 10	1 [9]	0	0%	26	-	0	1	2	3
57829-89-7 (DBP-TAZTO)	No	< 1	-	-	-	109	-	0	1	2	3
70156-79-5 (TBBPS-BME)	No	< 1	-	-	-	63	-	0	1	2	3
37419-42-4 (TBBPA-BP)	No	< 1	-	-	-	1.1	-	0	1	2	3
143-15-7	Yes	< 1	-	-	-	16	-	0	1	2	3
1715-40-8	Yes	≥ 1 - < 10	-	-	-	8.6	-	0	1	2	3
18300-04-4	Yes	≥ 1 - < 10	-	-	-	6.3	-	0	1	2	3
21609-90-5	Yes	≥ 1 - < 10	-	-	-	3.9	-	0	1	2	3
25495-98-1	Yes	< 1	-	-	-	21	-	0	1	2	3
33798-02-6	Yes	≥ 1 - < 10	-	-	-	8	-	0	1	2	3
39568-99-5	Yes	≥ 1 - < 10	-	-	-	7.7	-	0	1	2	3
4824-78-6	Yes	≥ 1 - < 10	-	-	-	6.2	-	0	1	2	3
52-51-7	Yes	≥ 100 - < 1 000	-	-	-	1.00E+04	-	2	1	0	3
55205-38-4	Yes	< 1	-	-	-	1.9	-	0	1	2	3
57117-31-4	Yes	≥ 1 - < 10	-	-	-	10	-	0	1	2	3
59447-57-3	Yes	< 1	-	-	-	19	-	0	1	2	3
6386-73-8	Yes	≥ 1 - < 10	-	-	-	51	-	0	1	2	3
75-25-2	Yes	≥ 100 - < 1 000	-	-	-	3.21E+05	-	2	1	0	3

Table S7 (continued) : Ranking of the 148 reported nBFRs based on European production or import, occurrence and ecotoxicology

Identity	A - Registration / Production		B - Occurrence			C - Ecotoxicology		Score for relevance ranking			
	CAS Number (Acronym) ¹	US EPA ²	ECHA (ton/year)	nBFR analyzed (number of studies)	nBFR detected (number of studies)	%	LC ₅₀ on fish. 96h (µg/L)	Trophic Magnification Factor ³	A	B	C
38521-51-6 (PBBB)	Yes	≥ 1 - < 10	9 [4] [25] [67] [79] [82] [90] [92] [107] [108]	1 [79]	11%	7.5	-	0	0	2	2
87-84-3 (PBCCH)	Yes	≥ 1 - < 10	3 [4] [13] [108]	1 [13]	33%	1560	-	0	1	1	2
607-99-8 (2.4.6-TBA)	Yes	< 1	2 [6] [25]	0	0%	973	-	0	1	1	2
636-28-2 (TeBB)	Yes	≥ 1 - < 10	2 [15] [113]	1 [113]	50%	208	-	0	1	1	2
31780-26-4 (DBS)	No	≥ 1 - < 10	1 [4]	0	0%	600	-	0	1	1	2
632-79-1 (TEBP-Anh)	Yes	≥ 10 - < 100	1 [4]	1 [4]	100%	210	-	0	1	1	2
105-36-2	Yes	≥ 1 - < 10	-	-	-	790	-	0	1	1	2
31454-48-5	Yes	≥ 1 - < 10	-	-	-	434	-	0	1	1	2
36678-45-2	Yes	≥ 1 - < 10	-	-	-	445	-	0	1	1	2
5445-17-0	Yes	≥ 1 - < 10	-	-	-	806	-	0	1	1	2
5445-19-2	Yes	≥ 1 - < 10	-	-	-	672	-	0	1	1	2
55481-60-2	Yes	< 1	-	-	-	533	-	0	1	1	2
66108-37-0	Yes	≥ 1 - < 10	-	-	-	620	-	0	1	1	2
7347-19-5	Yes	≥ 1 - < 10	-	-	-	544	-	0	1	1	2
7436-90-0	Yes	< 1	-	-	-	600	-	0	1	1	2
93-52-7	Yes	≥ 1 - < 10	-	-	-	920	-	0	1	1	2
96-32-2	Yes	< 1	-	-	-	829	-	0	1	1	2
106-41-2 (4-BP)	Yes	≥ 1 - < 10	3 [6] [121] [125]	2 [121] [125]	67%	12500	-	0	1	0	1
608-33-3 (2.6-DBP)	Yes	≥ 1 - < 10	3 [3] [4] [6]	1 [3]	33%	4430	-	0	1	0	1
615-58-7 (2.4-DBP)	Yes	≥ 1 - < 10	5 [3] [4] [5] [6] [121]	2 [3] [121]	40%	4430	-	0	1	0	1

Table S7 (continued) : Ranking of the 148 reported nBFRs based on European production or import, occurrence and ecotoxicology

Identity	A - Registration / Production		B - Occurrence			C - Ecotoxicology		Score for relevance ranking			
	CAS Number (Acronym) ¹	US EPA ²	ECHA (ton/year)	nBFR analyzed (number of studies)	nBFR detected (number of studies)	%	LC ₅₀ on fish. 96h (µg/L)	Trophic Magnification Factor ³	A	B	C
126-72-7 (TDBPP)	Yes	≥ 1 - < 10	1 [13]	1 [13]	100%	4040	-	0	1	0	1
1522-92-5 36483-57-5 (TBNPA)	Yes	< 1	1 [4]	0	0%	159000	-	0	1	0	1
168434-45-5 (TBPD-TBP)	No	< 1	-	-	-	Not found	-	0	1	0	1
20566-35-2 (HEEHP-TEBP)	Yes	< 1	-	-	-	5990	-	0	1	0	1
75795-16-3 (BDBP-TAZTO)	No	< 1	-	-	-	Not found	-	0	1	0	1
103-63-9	Yes	≥ 1 - < 10	-	-	-	8850	-	0	1	0	1
109678-33-3	Yes	Confidential	-	-	-	114000	-	0	1	0	1
124-73-2	Yes	≥ 1 - < 10	-	-	-	29300	-	0	1	0	1
13810-83-8	Yes	< 1 t	-	-	-	17200	-	0	1	0	1
147-82-0	Yes	≥ 1 - < 10	-	-	-	2580	-	0	1	0	1
14925-39-4	Yes	≥ 1 - < 10	-	-	-	64300	-	0	1	0	1
1837-91-8	Yes	< 1 t	-	-	-	1410	-	0	1	0	1
19660-16-3	Yes	≥ 1 - < 10	-	-	-	3180	-	0	1	0	1
20217-01-0	Yes	≥ 1 - < 10	-	-	-	5.35E+03	-	0	1	0	1
2623-87-2	Yes	≥ 1 - < 10	-	-	-	4620000	-	0	1	0	1
3234-02-4	Yes	≥ 1 - < 10	-	-	-	14100	-	0	1	0	1
353-59-3	Yes	≥ 1 - < 10	-	-	-	165000	-	0	1	0	1
40703-79-5	Yes	≥ 1 - < 10	-	-	-	14300	-	0	1	0	1
42597-49-9	Yes	≥ 1 - < 10	-	-	-	2360	-	0	1	0	1
52907-07-0	Yes	≥ 1 - < 10	-	-	-	23800	-	0	1	0	1
5324-12-9	Yes	< 1	-	-	-	2470000	-	0	1	0	1
5412-25-9	Yes	≥ 1 - < 10	-	-	-	136000	-	0	1	0	1
58495-09-3	Yes	< 1	-	-	-	Not found	-	0	1	0	1
591-20-8	Yes	≥ 1 - < 10	-	-	-	12500	-	0	1	0	1

Table S7 (continued) : Ranking of the 148 reported nBFRs based on European production or import, occurrence and ecotoxicology

Identity	A - Registration / Production		B - Occurrence			C - Ecotoxicology		Score for relevance ranking			
	CAS Number (Acronym) ¹	US EPA ²	ECHA (ton/year)	nBFR analyzed (number of studies)	nBFR detected (number of studies)	%	LC ₅₀ on fish. 96h (µg/L)	Trophic Magnification Factor ³	A	B	C
593-60-2	Yes	< 1	-	-	-	9340	-	0	1	0	1
59789-51-4	Yes	< 1	-	-	-	Not found	-	0	1	0	1
598-72-1	Yes	< 1	-	-	-	1460000	-	0	1	0	1
7415-86-3	Yes	≥ 1 - < 10	-	-	-	1270	-	0	1	0	1
75-63-8	Yes	< 1	-	-	-	285000	-	0	1	0	1
75-95-6	Yes	≥ 1 - < 10	-	-	-	13800	-	0	1	0	1
79-08-3	Yes	< 1	-	-	-	3130000	-	0	1	0	1
79-27-6	Yes	≥ 1 - < 10	-	-	-	90900	-	0	1	0	1
79-28-7	Yes	≥ 1 - < 10	-	-	-	4580	-	0	1	0	1
95-56-7	Yes	≥ 1 - < 10	-	-	-	12500	-	0	1	0	1
102739-99-1	Yes	Not registered	-	-	-	-	-	-	-	-	-
103582-29-2	Yes	Not registered	-	-	-	-	-	-	-	-	-
107555-93-1	Yes	Not registered	-	-	-	-	-	-	-	-	-
107555-94-2	Yes	Not registered	-	-	-	-	-	-	-	-	-
107555-95-3	Yes	Not registered	-	-	-	-	-	-	-	-	-
109333-34-8	Yes	Not registered	-	-	-	-	-	-	-	-	-
110999-44-5	Yes	Not registered	-	-	-	-	-	-	-	-	-
110999-45-6	Yes	Not registered	-	-	-	-	-	-	-	-	-
110999-46-7	Yes	Not registered	-	-	-	-	-	-	-	-	-
110999-47-8	Yes	Not registered	-	-	-	-	-	-	-	-	-
129880-08-6	Yes	Not registered	-	-	-	-	-	-	-	-	-
131166-92-2	Yes	Not registered	-	-	-	-	-	-	-	-	-
1403456-28-9	Yes	Not registered	-	-	-	-	-	-	-	-	-
161880-49-5	Yes	Not registered	-	-	-	-	-	-	-	-	-
161880-50-8	Yes	Not registered	-	-	-	-	-	-	-	-	-
161880-51-9	Yes	Not registered	-	-	-	-	-	-	-	-	-
1991993-66-8	Yes	Not registered	-	-	-	-	-	-	-	-	-
1991993-68-0	Yes	Not registered	-	-	-	-	-	-	-	-	-
1991993-69-1	Yes	Not registered	-	-	-	-	-	-	-	-	-

Table S7 (continued) : Ranking of the 148 reported nBFRs based on European production or import, occurrence and ecotoxicology

Identity	A - Registration / Production		B - Occurrence			C - Ecotoxicology		Score for relevance ranking				
	CAS Number (Acronym) ¹	US EPA ²	ECHA (ton/year)	nBFR analyzed (number of studies)	nBFR detected (number of studies)	%	LC ₅₀ on fish. 96h (µg/L)	Trophic Magnification Factor ³	A	B	C	Total
1991993-70-4	Yes	Not registered	-	-	-	-	-	-	-	-	-	-
2167063-57-0	Yes	Not registered	-	-	-	-	-	-	-	-	-	-
2170-45-8	Yes	Not registered	-	-	-	-	-	-	-	-	-	-
24173-07-7	Yes	Not registered	-	-	-	-	-	-	-	-	-	-
26657-83-0	Yes	Not registered	-	-	-	-	-	-	-	-	-	-
3066-70-4	Yes	Not registered	-	-	-	-	-	-	-	-	-	-
31611-84-4	Yes	Not registered	-	-	-	-	-	-	-	-	-	-
50585-41-6	Yes	Not registered	-	-	-	-	-	-	-	-	-	-
52434-59-0	Yes	Not registered	-	-	-	-	-	-	-	-	-	-
57011-47-9	Yes	Not registered	-	-	-	-	-	-	-	-	-	-
67733-57-7	Yes	Not registered	-	-	-	-	-	-	-	-	-	-
7046-64-2	Yes	Not registered	-	-	-	-	-	-	-	-	-	-
79755-43-4	Yes	Not registered	-	-	-	-	-	-	-	-	-	-
71245-27-7	Yes	Not registered	-	-	-	-	-	-	-	-	-	-
860302-33-6	Yes	Not registered	-	-	-	-	-	-	-	-	-	-

¹ Acronyms given by Bergman et al., 2012 [126]. For compounds not reported by Bergman et al., 2012, commonly used acronyms were given.

² nBFRs not registered by the US EPA (« No ») were found in the literature [126]

³ Trophic Magnification Factor was established in a zooplankton – invertebrate – fish – bird food chain in the literature [127]

⁴ TTBNPP, TTBP-TAZ and DBNPG were ranked according to their production quantities registered by the ECHA in 2021 rather than 2023

Table S8 : Chemical and physical properties of the 22 nBFRs targeted : molecular weight (MW), log Kow (computed by XLogP3 3.0, PubChem), water solubility (predicted with ECOSAR), ebullition temperature (predicted with ACD/Labs Percepta Platform - PhysChem Module, version: 14.00) and score at the relevance ranking

(Acronym) ¹	CAS Number	Full name	MW (g.mol ⁻¹)	Log Kow	Water solubility (µg.L ⁻¹)	Boiling Point (°C at 760 mmHg)	Score
2,4-DBP	615-58-7	2,4-Dibromophenol	251.90	3.2	1.131E+06	238.5±0.0 °C	1
2,4,6-TBP	118-79-6	2,4,6-Tribromophenol	330.80	4.4	3.3224E+04	286.8±0.0	5
BEH-TEBP	26040-51-7	Bis(2-ethylhexyl) tetrabromophthalate	706.1	10.6	1.9828E-06	584.8±45.0	8
BTBPE	37853-59-1	1,2-Bis(2,4,6-tribromophenoxy)ethane	687.6	7.7	6.5509E-04	566.4±50.0	7
DBDPE	84852-53-9	Decabromodiphenyl ethane	971.2	11.1	1.1612E-09	676.2±50.0	9
DBE-DBCH	3322-93-8	4-(1,2-Dibromoethyl)-1,2-dibromocyclohexane	427.80	4.6	6.9147E+01	371.2±22.0	5
DBHCTD	51936-55-1	Hexachlorocyclopentadienyl-dibromocyclooctane	540.8	6.4	6.8425E-02	480.7±45.0	6
EH-TBB	183658-27-7	2-Ethylhexyl 2,3,4,5-tetrabromobenzoate	549.9	7.7	1.1437E-02	477.5±40.0	6
HBB	87-82-1	Hexabromobenzene	551.5	6.1	1.2778E-01	417.5±40.0	6
PBB-Acr	59447-55-1	Pentabromobenzyl acrylate	556.7	5.7	4.062E-01	477.7±40.0	7
PBBB	38521-51-6	Pentabromobenzyl bromide	565.5	5.9	1.4737E-01	460.4±40.0	2
PBBz	608-90-2	Pentabromobenzene	472.59	5.4	2.8292	376.1±37.0	6
PBEB	85-22-3	Pentabromoethylbenzene	500.64	6.2	3.9697E-01	413.3±40.0	6
PBP	608-71-9	Pentabromophenol	488.59	5	1.5962E+01	352.3±37.0	4
PBT	87-83-2	Pentabromotoluene	486.62	5.7	5.2712E-02	394.4±37.0	6
TBBPA	79-94-7	Tetrabromobisphenol A	543.9	6.8	2.1461	417.9±40.0	9
TBBPA-BDBPE	21850-44-2	Tetrabromobisphenol A bis(2,3dibromopropyl) ether	943.6	10.6	1.1642E-07	676.5±55.0	9
TBBPS-BME	70156-79-5	Tetrabromobisphenol S bismethyl ether	593.9	5.4	6.9385E-01	590.9±50.0	3
TBP-AE	3278-89-5	2,4,6-Tribromophenyl allyl ether	370.86	4.7	7.7929E+01	339.5±37.0	4
TBX	23488-38-2	2,3,5,6-Tetrabromo-p-xylene	421.75	5.4	4.7168	361.3±37.0	4
TDBP-TAZTO	52434-90-9	1,3,5-Tris(2,3-dibromopropyl) isocyanurate	728.7	4.1	1.1401E-02	618.8±55.0	7
TTBP-TAZ	25713-60-4	Tris(2,4,6-tribromophenoxy)-s-triazine	1067.4	11.8	1.8493E-08	812.2±75.0	6

¹ Acronyms given by Bergman et al., 2012 [126]. For compounds not reported by Bergman et al., 2012, commonly used acronyms were given.

Table S9 : Concentrations of 38 halogenated flame retardants targeted in the suspended matter samples

	FOS	NIO	VEY	EST	MAI	SAM	CHE	SMH	SMN	PRA
nBFRs (ng.g ⁻¹ d.w.)										
2.4-DBP	3.80	4.89	3.42	4.14	6.75	0.16	1.86	12.49	9.61	2.16
2.4.6-TBP	0.57	0.89	1.46	2.44	0.94	0.12	1.40	3.19	1.28	1.64
BEH-TEBP	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
BTBPE	< LOD	< LOD	2.37	< LOD	0.86	< LOD	< LOD	< LOD	< LOD	< LOD
DBDPE	< LOD	< LOD	< LOQ	< LOD	7.51	< LOQ	< LOD	< LOQ	< LOQ	< LOD
DBE-DBCH	0.09	0.14	0.33	2.56	0.05	0.08	0.15	0.53	0.24	1.48
DBHCTD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
EH-TBB	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
HBB	< LOD	< LOD	< LOD	< LOD	0.10	< LOD	< LOD	< LOD	< LOD	< LOQ
PBB-Acr	0.35	0.73	1.27	2.98	0.51	< LOD	2.39	1.89	0.83	1.85
PBBB	0.18	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOQ	0.19	< LOD
PBBz	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
PBEB	< LOD	< LOQ	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
PBP	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
PBT	< LOQ	< LOQ	< LOD	< LOD	< LOQ	< LOD	< LOD	< LOD	< LOD	< LOD
TBBPA	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
TBBPA-BDBPE	< LOD	< LOD	< LOQ	< LOD	< LOQ	< LOD	< LOD	< LOQ	< LOQ	< LOD
TBBPS-BME	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
TBP-AE	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	0.37	< LOQ	< LOD
TBX	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
TDBP-TAZTO	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
TTBP-TAZ	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
PBDEs (ng.g ⁻¹ d.w.)										
BDE 28	< LOQ	< LOQ	< LOD	< LOD	0.09	< LOD	< LOD	< LOD	< LOD	< LOD
BDE 47	0.16	3.35	< LOD	0.41	2.16	< LOQ	< LOD	0.30	0.25	11.71
BDE 99	< LOQ	0.18	< LOD	< LOQ	0.13	0.06	3.54	0.60	0.70	< LOQ
BDE 100	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
BDE 153	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
BDE 154	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
BDE 183	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
BDE 209	17.74	< LOQ	< LOQ	< LOD	19.96	< LOQ	< LOQ	< LOQ	< LOQ	< LOQ

Table S9 (continued) : Concentrations of 38 halogenated flame retardants targeted in the suspended matter samples

	FOS	NIO	VEY	EST	MAI	SAM	CHE	SMH	SMN	PRA
PCBs (ng.g ⁻¹ d.w.)										
PCB 28	0.28	0.39	0.59	1.47	1.07	0.13	1.18	0.38	0.76	0.80
PCB 52	0.10	0.27	0.17	0.61	1.28	0.25	0.41	0.13	0.41	0.31
PCB 101	0.21	0.75	0.55	1.92	2.40	0.12	1.37	0.36	0.97	0.82
PCB 118	0.26	1.08	0.74	3.11	3.67	0.13	1.92	0.59	1.64	1.07
PCB 138	0.38	1.83	1.56	5.16	6.84	0.11	3.43	0.93	2.65	1.12
PCB 153	0.42	1.94	1.37	5.66	8.14	0.12	3.26	0.96	2.74	1.24
PCB 180	0.32	0.92	1.26	3.91	3.39	0.16	2.34	0.75	1.88	1.06
CPs (ng.g ⁻¹ d.w.)										
CPs	184	257	< LOD	267	42	< LOD	323	< LOD	233	< LOD

Table S10 : Non-parametric Spearman rank correlation across the detected compounds

	nBFRs											PBDEs				PCBs						CPs			
	2,4-DBP	2,4,6-TBP	BTBPE	DBDPE	DBE-DBCH	HBB	PBB-Acr	PBBB	PBT	TBBPA-BDBPE	TBP-AE	BDE 28	BDE 47	BDE 99	BDE 209	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	CPs		
nBFRs	2,4-DBP																								
	2,4,6-TBP	0,297																							
	BTBPE	0,0519	0,0259																						
	DBDPE	0,3551	-0,0804	0,5977																					
	DBE-DBCH	0,1152	0,8788***	-0,2076	-0,3618																				
	HBB	0,0432	0,0519	0,3642	0,2582	-0,1557																			
	PBB-Acr	0,103	0,8909***	-0,147	-0,3551	0,8303	-0,1211																		
	PBBB	0,5443	-0,0373	-0,3193	0,1237	0,0075	-0,3193	-0,1566																	
	PBT	0,2659	-0,5698	0,1627	-0,042	-0,6458*	0,2711	-0,5698	0,0467																
	TBBPA-BDBPE	0,6396*	0,2843	0,6086	0,825**	0	0,1521	0	0,3497	-0,0891															
TBP-AE	0,4719	0,5394	-0,3208	0,1615	0,4944	0,1123	0,2922	0,5254	-0,4226	0,3953															
PBDEs	BDE 28	0,2922	-0,5394	0,2566	0,0745	-0,6742*	0,3849	-0,5618	0	0,986***	0	-0,4167													
	BDE 47	0,4073	0,1824	-0,1865	-0,1579	0,1885	0,59	0,0486	-0,1271	0,3429	-0,1069	0,3156	0,3607												
	BDE 99	0,3252	-0,0429	-0,3941	0,1085	-0,2147	-0,1489	0,1288	0,2793	-0,0385	0,1439	0,2958	-0,0228	-0,0492											
	BDE 209	0,1268	-0,5294	0,3725	0,371	-0,7531*	0,4789	-0,6636*	0,2294	0,7011*	0,2623	-0,1383	0,7466*	0,0075	0,0377										
PCBs	PCB 28	0,0424	0,503	0,147	-0,1876	0,3939	0,3546	0,6848*	-0,3654	-0,1899	0	-0,0899	-0,1124	0,2128	0,1043	-0,2908									
	PCB 52	0,0973	0,1337	0,1128	0,0907	0,0243	0,4685	0,2979	-0,3665	-0,0381	0,0356	-0,1465	0,0676	0,3262	0,2708	-0,1421	0,8389**								
	PCB 101	0,2485	0,3333	0,2076	0	0,1636	0,4671	0,4788	-0,2759	0,038	0,1421	-0,0899	0,1348	0,3343	0,2393	-0,082	0,9394***	0,924***							
	PCB 118	0,297	0,2727	0,2076	0	0,103	0,3892	0,4424	-0,2759	0,114	0,1421	-0,1573	0,2023	0,3222	0,2884	-0,082	0,903***	0,9119***	0,9879****						
	PCB 138	0,3091	0,2606	0,3027	0,0603	0,0788	0,3114	0,4303	-0,2759	0,114	0,2132	-0,2247	0,2023	0,2188	0,2638	-0,082	0,8788***	0,8754***	0,9636****	0,9879****					
	PCB 153	0,3091	0,2606	0,3027	0,0603	0,0788	0,3114	0,4303	-0,2759	0,114	0,2132	-0,2247	0,2023	0,2188	0,2638	-0,082	0,8788***	0,8754***	0,9636****	0,9879****	1****				
	PCB 180	0,2	0,4303	0,32	0,0268	0,2848	0,2941	0,5758	-0,2759	-0,114	0,2132	-0,1573	-0,0225	0,1277	0,1043	-0,2162	0,9515****	0,8511**	0,9515****	0,9394****	0,9515****	0,9515****			
CPs	CPs	0,0688	-0,0688	-0,3347	-0,515	-0,0063	-0,2901	0,3314	-0,0077	0,196	-0,3666	-0,3826	0,1623	-0,0282	0,4305	-0,2231	0,544	0,4955	0,5565	0,6253*	0,6253*	0,6253*	0,5378		

p-values are indicated with the respective symbols : * for 0.05>p>0.01, ** for 0.01>p>0.001, *** for 0.001>p>0.0001 and **** for p<0.0001. Significant correlations are displayed for p-values < 0,05.

Table S11 : Toxicity of the detected nBFRs (a) and risk quotients (RQ) obtained with EMP method (b) and C_{PW} method (c)

a) Toxicity of the detected nBFRs

	K_{OC} (pH 7.4) ¹	Toxicity ($\mu\text{g/L}$)	$PNEC_{\text{water}}$ ($\mu\text{g.L}^{-1}$) ⁶	$PNEC_{\text{sediment}}$ ($\mu\text{g.kg}^{-1}$) ⁷
2,4-DBP	1101.8	790 ²	0.79	19.5
2,4,6-TBP	314.7	260 ³	0.26	2.0
DBDPE	10000000	19 ⁴	0.019	4123.0
HBB	54002.4	10700 ⁵	10.7	12547.2

¹ K_{OC} obtained with Chempider (<https://www.chemspider.com/>), predicted with ACD/Labs Percepta Platform - PhysChem Module, version: 14.00

² LC_{50} , 96h, Green algae, Saltwater, obtained from ECOSAR

³ EC_{50} , 48h, Daphnia magna, obtained from SIDS Initial Assessment Report, 2,4,6-Tribromophenol, 2003 (<https://hpvchemicals.oecd.org/UI/handler.axd?id=4b0a638b-3346-4217-8549-94637f6c0d32>)

⁴ EC_{50} , 48h, Daphnia magna, obtained from Xiong, et al., 2019, DOI: 10.1021/acs.est.9b03159

⁵ LC_{50} , embryo mortality, Zebrafish, obtained from Xiong, et al., 2019, DOI: 10.1021/acs.est.9b03159

⁶ $PNEC_{\text{water}} = LC_{50}$ or $EC_{50} / 1000$

⁷ $PNEC_{\text{sediment}} = (0.783 + 0.0217 * K_{OC}) * PNEC_{\text{water}}$

b) Risk quotients obtained with the EPM method ($RQ = MEC / PNEC_{\text{sediments}}$)

	FOS	NIO	VEY	EST	MAI	SAM	CHE	SMH	SMN	PRA
2,4-DBP	0.2	0.3	0.2	0.2	0.3	0.008	0.095	0.6	0.5	0.1
2,4,6-TBP	0.3	0.4	0.7	1.2	0.5	0.06	0.7	1.6	0.6	0.8
DBDPE	-	-	-	-	0.002	-	-	-	-	-
HBB	-	-	-	-	0.00001	-	-	-	-	-

$RQ < 0.01$: very low risk

$0.01 \leq RQ < 0.1$: low risk

$0.1 \leq RQ < 1$: medium risk

$RQ \geq 1$: high risk

c) Risk quotients obtained with the C_{PW} * method from Di Toro et al., 1991 ($RQ = C_{PW} / PNEC_{\text{water}}$)

	FOS	NIO	VEY	EST	MAI	SAM	CHE	SMH	SMN	PRA
2,4-DBP	0.4	0.3	0.1	0.095	0.2	0.004	0.04	0.3	0.2	0.03
2,4,6-TBP	0.7	0.6	0.5	0.6	0.4	0.035	0.3	0.8	0.3	0.2
DBDPE	-	-	-	-	0.00124	-	-	-	-	-
HBB	-	-	-	-	0.00001	-	-	-	-	-

$RQ < 0.01$: very low risk

$0.01 \leq RQ < 0.1$: low risk

$0.1 \leq RQ < 1$: medium risk

$RQ \geq 1$: high risk

* $C_{PW} = \frac{C_s}{f_{oc} * K_{OC}}$, with C_s the concentration in sediments (Table S9), f_{oc} the TOC (Table S1) and K_{OC} given in Table S11a

Bibliography

- [1] A. P. Ganci, C. H. Vane, M. A.-E. Abdallah, T. Moehring, et S. Harrad, « Legacy PBDEs and NBRs in sediments of the tidal River Thames using liquid chromatography coupled to a high resolution accurate mass Orbitrap mass spectrometer », *Science of The Total Environment*, vol. 658, p. 1355-1366, mars 2019, doi: 10.1016/j.scitotenv.2018.12.268.
- [2] J. Xiong, G. Li, T. An, C. Zhang, et C. Wei, « Emission patterns and risk assessment of polybrominated diphenyl ethers and bromophenols in water and sediments from the Beijiang River, South China », *Environmental Pollution*, vol. 219, p. 596-603, déc. 2016, doi: 10.1016/j.envpol.2016.06.021.
- [3] F. Han *et al.*, « Solid-phase extraction of seventeen alternative flame retardants in water as determined by ultra-high-performance liquid chromatography-tandem mass spectrometry », *Journal of Chromatography A*, vol. 1602, p. 64-73, sept. 2019, doi: 10.1016/j.chroma.2019.05.048.
- [4] J. Gustavsson, K. Wiberg, E. Ribeli, M. A. Nguyen, S. Josefsson, et L. Ahrens, « Screening of organic flame retardants in Swedish river water », *Science of The Total Environment*, vol. 625, p. 1046-1055, juin 2018, doi: 10.1016/j.scitotenv.2017.12.281.
- [5] V. Svihlikova, D. Lankova, J. Poustka, M. Tomaniova, J. Hajslova, et J. Pulkrabova, « Perfluoroalkyl substances (PFASs) and other halogenated compounds in fish from the upper Labe River basin », *Chemosphere*, vol. 129, p. 170-178, juin 2015, doi: 10.1016/j.chemosphere.2014.09.096.
- [6] G. Poma *et al.*, « Occurrence of selected halogenated flame retardants in Belgian foodstuff », *Chemosphere*, vol. 194, p. 256-265, mars 2018, doi: 10.1016/j.chemosphere.2017.11.179.
- [7] A. Vénisseau *et al.*, « Occurrence of legacy and novel brominated flame retardants in food and feed in France for the period 2014 to 2016 », *Chemosphere*, vol. 207, p. 497-506, sept. 2018, doi: 10.1016/j.chemosphere.2018.05.122.
- [8] Y. Hu *et al.*, « Halogenated flame retardants in mangrove sediments from the Pearl River Estuary, South China: Comparison with historical data and correlation with microbial community », *Chemosphere*, vol. 227, p. 315-322, juill. 2019, doi: 10.1016/j.chemosphere.2019.04.075.
- [9] L. Liu *et al.*, « Determination of tetrabromobisphenol-A/S and their main derivatives in water samples by high performance liquid chromatography coupled with inductively coupled plasma tandem mass spectrometry », *Journal of Chromatography A*, vol. 1497, p. 81-86, mai 2017, doi: 10.1016/j.chroma.2017.03.040.
- [10] M. Kotthoff, H. Rüdél, et H. Jüring, « Detection of tetrabromobisphenol A and its mono- and dimethyl derivatives in fish, sediment and suspended particulate matter from European freshwaters and estuaries », *Anal Bioanal Chem*, vol. 409, n° 14, p. 3685-3694, mai 2017, doi: 10.1007/s00216-017-0312-z.
- [11] A. R. Fernandes, D. Mortimer, M. Rose, F. Smith, S. Panton, et M. Garcia-Lopez, « Bromine content and brominated flame retardants in food and animal feed from the UK », *Chemosphere*, vol. 150, p. 472-478, mai 2016, doi: 10.1016/j.chemosphere.2015.12.042.
- [12] H. Li *et al.*, « Brominated and organophosphate flame retardants along a sediment transect encompassing the Guiyu, China e-waste recycling zone », *Science of The Total Environment*, vol. 646, p. 58-67, janv. 2019, doi: 10.1016/j.scitotenv.2018.07.276.
- [13] H.-H. Liu *et al.*, « Occurrence of Halogenated Flame Retardants in Sediment off an Urbanized Coastal Zone: Association with Urbanization and Industrialization », *Environ. Sci. Technol.*, vol. 48, n° 15, p. 8465-8473, août 2014, doi: 10.1021/es500660z.
- [14] E. Barón *et al.*, « Occurrence of hydrophobic organic pollutants (BFRs and UV-filters) in sediments from South America », *Chemosphere*, vol. 92, n° 3, p. 309-316, juill. 2013, doi: 10.1016/j.chemosphere.2013.03.032.
- [15] H. Zhang et B. C. Kelly, « Sorption and bioaccumulation behavior of multi-class hydrophobic organic contaminants in a tropical marine food web », *Chemosphere*, vol. 199, p. 44-53, mai 2018, doi: 10.1016/j.chemosphere.2018.01.173.

- [16] A. Liu, G. Qu, M. Yu, Y. Liu, J. Shi, et G. Jiang, « Tetrabromobisphenol-A/S and Nine Novel Analogs in Biological Samples from the Chinese Bohai Sea: Implications for Trophic Transfer », *Environ. Sci. Technol.*, vol. 50, n° 8, p. 4203-4211, avr. 2016, doi: 10.1021/acs.est.5b06378.
- [17] G. Qu *et al.*, « Identification of Tetrabromobisphenol A Allyl Ether and Tetrabromobisphenol A 2,3-Dibromopropyl Ether in the Ambient Environment near a Manufacturing Site and in Mollusks at a Coastal Region », *Environ. Sci. Technol.*, vol. 47, n° 9, p. 4760-4767, mai 2013, doi: 10.1021/es3049916.
- [18] Y. Hao *et al.*, « Novel brominated and organophosphate flame retardants in the atmosphere of Fildes Peninsula, West Antarctica: Continuous observations from 2011 to 2020 », *Journal of Hazardous Materials*, vol. 440, p. 129776, oct. 2022, doi: 10.1016/j.jhazmat.2022.129776.
- [19] J. R. Nyholm, R. Grabic, H. P. H. Arp, T. Moskeland, et P. L. Andersson, « Environmental occurrence of emerging and legacy brominated flame retardants near suspected sources in Norway », *Science of The Total Environment*, vol. 443, p. 307-314, janv. 2013, doi: 10.1016/j.scitotenv.2012.10.081.
- [20] J. Liu, C. Liang, B. Peng, Y.-Y. Zhang, L.-Y. Liu, et E. Y. Zeng, « Legacy and alternative flame retardants in typical freshwater cultured fish ponds of South China: Implications for evolving industry and pollution control », *Science of The Total Environment*, vol. 763, p. 143016, avr. 2021, doi: 10.1016/j.scitotenv.2020.143016.
- [21] M. Nipen *et al.*, « Increasing Trends of Legacy and Emerging Organic Contaminants in a Dated Sediment Core From East-Africa », *Front. Environ. Sci.*, vol. 9, p. 805544, janv. 2022, doi: 10.3389/fenvs.2021.805544.
- [22] B. Zhu, J. C. W. Lam, et P. K. S. Lam, « Halogenated flame retardants (HFRs) in surface sediment from the Pearl River Delta region and Mirs Bay, South China », *Marine Pollution Bulletin*, vol. 129, n° 2, p. 899-904, avr. 2018, doi: 10.1016/j.marpolbul.2017.10.046.
- [23] B. Zhu, J. C. W. Lam, S. Yang, et P. K. S. Lam, « Conventional and emerging halogenated flame retardants (HFRs) in sediment of Yangtze River Delta (YRD) region, East China », *Chemosphere*, vol. 93, n° 3, p. 555-560, sept. 2013, doi: 10.1016/j.chemosphere.2013.06.052.
- [24] H. Feng *et al.*, « Occurrence and spatial distribution of legacy and novel brominated flame retardants in seawater and sediment of the South China sea », *Environmental Pollution*, vol. 271, p. 116324, févr. 2021, doi: 10.1016/j.envpol.2020.116324.
- [25] R. Sühling, F. Busch, N. Fricke, D. Kötker, H. Wolschke, et R. Ebinghaus, « Distribution of brominated flame retardants and dechloranes between sediments and benthic fish — A comparison of a freshwater and marine habitat », *Science of The Total Environment*, vol. 542, p. 578-585, janv. 2016, doi: 10.1016/j.scitotenv.2015.10.085.
- [26] P. Carlsson, B. Vrana, J. Sobotka, K. Borgå, P. Bohlin Nizzetto, et Ø. Varpe, « New brominated flame retardants and dechlorane plus in the Arctic: Local sources and bioaccumulation potential in marine benthos », *Chemosphere*, vol. 211, p. 1193-1202, nov. 2018, doi: 10.1016/j.chemosphere.2018.07.158.
- [27] Ò. Aznar-Alemany *et al.*, « Preliminary study of long-range transport of halogenated flame retardants using Antarctic marine mammals », *Science of The Total Environment*, vol. 650, p. 1889-1897, févr. 2019, doi: 10.1016/j.scitotenv.2018.09.287.
- [28] H. Wei *et al.*, « Polybromodiphenyl Ethers and Decabromodiphenyl Ethane in Aquatic Sediments from Southern and Eastern Arkansas, United States », *Environ. Sci. Technol.*, vol. 46, n° 15, p. 8017-8024, août 2012, doi: 10.1021/es301237w.
- [29] Z. Zhang *et al.*, « Polybrominated diphenyl ethers, decabromodiphenyl ethane and dechlorane plus in aquatic products from the Yellow River Delta, China », *Marine Pollution Bulletin*, vol. 161, p. 111733, déc. 2020, doi: 10.1016/j.marpolbul.2020.111733.
- [30] F. Wu *et al.*, « Polybrominated diphenyl ethers and decabromodiphenylethane in sediments from twelve lakes in China », *Environmental Pollution*, vol. 162, p. 262-268, mars 2012, doi: 10.1016/j.envpol.2011.11.014.

- [31] L. Fu, J. Pei, Y. Zhang, X. Cheng, S. Long, et L. Zeng, « Polybrominated diphenyl ethers and alternative halogenated flame retardants in mollusks from the Chinese Bohai Sea: Levels and interspecific differences », *Marine Pollution Bulletin*, vol. 142, p. 551-558, mai 2019, doi: 10.1016/j.marpolbul.2019.03.056.
- [32] X. Zhen *et al.*, « Polybrominated diphenyl ethers (PBDEs) and alternative brominated flame retardants (aBFRs) in sediments from four bays of the Yellow Sea, North China », *Environmental Pollution*, vol. 213, p. 386-394, juin 2016, doi: 10.1016/j.envpol.2016.02.042.
- [33] L. Liu, X. Zhen, X. Wang, D. Zhang, L. Sun, et J. Tang, « Spatio-temporal variations and input patterns on the legacy and novel brominated flame retardants (BFRs) in coastal rivers of North China », *Environmental Pollution*, vol. 283, p. 117093, août 2021, doi: 10.1016/j.envpol.2021.117093.
- [34] X. Zhang, Q. Xie, R.-Q. Yu, et Y. Wu, « Temporal Trends of Alternative Halogenated Flame Retardants in Humpback Dolphins from the South China Sea », *Environ. Sci. Technol.*, vol. 56, n° 8, p. 5037-5048, avr. 2022, doi: 10.1021/acs.est.1c08636.
- [35] C. Munsch, N. Olivier, B. Veyrand, et P. Marchand, « Occurrence of legacy and emerging halogenated organic contaminants in marine shellfish along French coasts », *Chemosphere*, vol. 118, p. 329-335, janv. 2015, doi: 10.1016/j.chemosphere.2014.09.106.
- [36] S. Mekni *et al.*, « Occurrence of halogenated flame retardants in sediments and sea urchins (*Paracentrotus lividus*) from a North African Mediterranean coastal lagoon (Bizerte, Tunisia) », *Science of The Total Environment*, vol. 654, p. 1316-1325, mars 2019, doi: 10.1016/j.scitotenv.2018.11.139.
- [37] S. Mekni, B. Barhoumi, S. Touil, M. R. Driss, et E. Eljarrat, « Occurrence of Halogenated and Organophosphate Flame Retardants in Sediments and Eels (*Anguilla anguilla*) From Bizerte Lagoon, Tunisia », *Front. Environ. Sci.*, vol. 8, p. 67, juin 2020, doi: 10.3389/fenvs.2020.00067.
- [38] M. Giulivo *et al.*, « Occurrence of halogenated and organophosphate flame retardants in sediment and fish samples from three European river basins », *Science of The Total Environment*, vol. 586, p. 782-791, mai 2017, doi: 10.1016/j.scitotenv.2017.02.056.
- [39] A. Lippold *et al.*, « Occurrence of emerging brominated flame retardants and organophosphate esters in marine wildlife from the Norwegian Arctic », *Environmental Pollution*, vol. 315, p. 120395, déc. 2022, doi: 10.1016/j.envpol.2022.120395.
- [40] Y. Hu *et al.*, « Occurrence and ecological risks of brominated flame retardants and dechlorane plus in sediments from the Pearl River Estuary and Daya Bay, South China », *Marine Pollution Bulletin*, vol. 185, p. 114182, déc. 2022, doi: 10.1016/j.marpolbul.2022.114182.
- [41] K. Vorkamp, R. Bossi, F. F. Rigét, H. Skov, C. Sonne, et R. Dietz, « Novel brominated flame retardants and dechlorane plus in Greenland air and biota », *Environmental Pollution*, vol. 196, p. 284-291, janv. 2015, doi: 10.1016/j.envpol.2014.10.007.
- [42] T. Portolés *et al.*, « Novel Analytical Approach for Brominated Flame Retardants Based on the Use of Gas Chromatography-Atmospheric Pressure Chemical Ionization-Tandem Mass Spectrometry with Emphasis in Highly Brominated Congeners », *Anal. Chem.*, vol. 87, n° 19, p. 9892-9899, oct. 2015, doi: 10.1021/acs.analchem.5b02378.
- [43] E. Villaverde-de-Sáa, C. Valls-Cantenys, J. B. Quintana, R. Rodil, et R. Cela, « Matrix solid-phase dispersion combined with gas chromatography–mass spectrometry for the determination of fifteen halogenated flame retardants in mollusks », *Journal of Chromatography A*, vol. 1300, p. 85-94, juill. 2013, doi: 10.1016/j.chroma.2013.05.064.
- [44] H.-K. Lee, S. Lee, J.-E. Lim, et H.-B. Moon, « Legacy and novel flame retardants in water and sediment from highly industrialized bays of Korea: Occurrence, source tracking, decadal time trend, and ecological risks », *Marine Pollution Bulletin*, vol. 160, p. 111639, nov. 2020, doi: 10.1016/j.marpolbul.2020.111639.
- [45] R. Rodil, E. Villaverde-de-Sáa, J. Cobas, J. B. Quintana, R. Cela, et N. Carro, « Legacy and emerging pollutants in marine bivalves from the Galician coast (NW Spain) », *Environment International*, vol. 129, p. 364-375, août 2019, doi: 10.1016/j.envint.2019.05.018.

- [46] Q. Wu *et al.*, « Historical trends and ecological risks of polybrominated diphenyl ethers (PBDEs) and alternative halogenated flame retardants (AHFRs) in a mangrove in South China », *Science of The Total Environment*, vol. 599-600, p. 181-187, déc. 2017, doi: 10.1016/j.scitotenv.2017.05.002.
- [47] H.-K. Lee, G. Bak, J.-E. Lim, J.-W. Lee, S. Lee, et H.-B. Moon, « Historical record of legacy and alternative halogenated flame retardants in dated sediment from a highly industrialized saltwater lake in Korea », *Chemosphere*, vol. 297, p. 134264, juin 2022, doi: 10.1016/j.chemosphere.2022.134264.
- [48] Z. Zhang *et al.*, « Halogenated organic pollutants in sediments and organisms from mangrove wetlands of the Jiulong River Estuary, South China », *Environmental Research*, vol. 171, p. 145-152, avr. 2019, doi: 10.1016/j.envres.2019.01.028.
- [49] X. Zhang *et al.*, « Halogenated organic contaminants of concern in urban-influenced waters of Lake Ontario, Canada: Passive sampling with targeted and non-targeted screening », *Environmental Pollution*, vol. 264, p. 114733, sept. 2020, doi: 10.1016/j.envpol.2020.114733.
- [50] J.-P. Wu *et al.*, « Halogenated flame retardants in wild, prey-sized mud carp from an e-waste recycling site in South China, 2006–2016: Residue dynamics and ecological risk assessment », *Environmental Pollution*, vol. 291, p. 118270, déc. 2021, doi: 10.1016/j.envpol.2021.118270.
- [51] Y. Li, X. Zhen, L. Liu, C. Tian, X. Pan, et J. Tang, « Halogenated flame retardants in the sediments of the Chinese Yellow Sea and East China Sea », *Chemosphere*, vol. 234, p. 365-372, nov. 2019, doi: 10.1016/j.chemosphere.2019.06.115.
- [52] J. Xie *et al.*, « Halogenated flame retardants in surface sediments from fourteen estuaries, South China », *Marine Pollution Bulletin*, vol. 164, p. 112099, mars 2021, doi: 10.1016/j.marpolbul.2021.112099.
- [53] J. Guo *et al.*, « Halogenated flame retardants in sediments from the Upper Laurentian Great Lakes: Implications to long-range transport and evidence of long-term transformation », *Journal of Hazardous Materials*, vol. 384, p. 121346, févr. 2020, doi: 10.1016/j.jhazmat.2019.121346.
- [54] G. Su, R. J. Letcher, D. J. McGoldrick, et S. M. Backus, « Halogenated Flame Retardants in Predator and Prey Fish From the Laurentian Great Lakes: Age-Dependent Accumulation and Trophic Transfer », *Environ. Sci. Technol.*, vol. 51, n° 15, p. 8432-8441, août 2017, doi: 10.1021/acs.est.7b02338.
- [55] Ò. Aznar-Alemany *et al.*, « Halogenated and organophosphorus flame retardants in European aquaculture samples », *Science of The Total Environment*, vol. 612, p. 492-500, janv. 2018, doi: 10.1016/j.scitotenv.2017.08.199.
- [56] Ò. Aznar-Alemany, B. Sala, S. Plön, H. Bouwman, D. Barceló, et E. Eljarrat, « Halogenated and organophosphorus flame retardants in cetaceans from the southwestern Indian Ocean », *Chemosphere*, vol. 226, p. 791-799, juill. 2019, doi: 10.1016/j.chemosphere.2019.03.165.
- [57] G. Poma, A. Binelli, P. Volta, C. Roscioli, et L. Guzzella, « Evaluation of spatial distribution and accumulation of novel brominated flame retardants, HBCD and PBDEs in an Italian subalpine lake using zebra mussel (*Dreissena polymorpha*) », *Environ Sci Pollut Res*, vol. 21, n° 16, p. 9655-9664, août 2014, doi: 10.1007/s11356-014-2826-7.
- [58] D. Zacs, L. E. Ikkere, et V. Bartkevics, « Emerging brominated flame retardants and dechlorane-related compounds in European eels (*Anguilla anguilla*) from Latvian lakes », *Chemosphere*, vol. 197, p. 680-690, avr. 2018, doi: 10.1016/j.chemosphere.2018.01.105.
- [59] G. Santín, E. Barón, E. Eljarrat, et D. Barceló, « Emerging and historical halogenated flame retardants in fish samples from Iberian rivers », *Journal of Hazardous Materials*, vol. 263, p. 116-121, déc. 2013, doi: 10.1016/j.jhazmat.2013.08.068.
- [60] J. Cristale et S. Lacorte, « Development and validation of a multiresidue method for the analysis of polybrominated diphenyl ethers, new brominated and organophosphorus flame retardants in sediment, sludge and dust », *Journal of Chromatography A*, vol. 1305, p. 267-275, août 2013, doi: 10.1016/j.chroma.2013.07.028.

- [61] A. Q. Hoang *et al.*, « Determination of brominated flame retardants including polybrominated diphenyl ethers, pentabromoethylbenzene, hexabromobiphenyl, and decabromodiphenyl ethane in sediment samples: Validation of a rapid and efficient clean-up method and application to a sediment core from Lake Biwa, Japan », *Chemosphere*, vol. 281, p. 130867, oct. 2021, doi: 10.1016/j.chemosphere.2021.130867.
- [62] J. Guo, K. Romanak, S. Westenbroek, R. A. Hites, et M. Venier, « Current-Use Flame Retardants in the Water of Lake Michigan Tributaries », *Environ. Sci. Technol.*, vol. 51, n° 17, p. 9960-9969, sept. 2017, doi: 10.1021/acs.est.7b01294.
- [63] S.-J. Chen, A.-H. Feng, M.-J. He, M.-Y. Chen, X.-J. Luo, et B.-X. Mai, « Current levels and composition profiles of PBDEs and alternative flame retardants in surface sediments from the Pearl River Delta, southern China: Comparison with historical data », *Science of The Total Environment*, vol. 444, p. 205-211, févr. 2013, doi: 10.1016/j.scitotenv.2012.11.104.
- [64] A. Q. Hoang, D. Aono, I. Watanabe, M. Kuwae, T. Kunisue, et S. Takahashi, « Contamination levels and temporal trends of legacy and current-use brominated flame retardants in a dated sediment core from Beppu Bay, southwestern Japan », *Chemosphere*, vol. 266, p. 129180, mars 2021, doi: 10.1016/j.chemosphere.2020.129180.
- [65] Q. Wu *et al.*, « Contamination and distribution of heavy metals, polybrominated diphenyl ethers and alternative halogenated flame retardants in a pristine mangrove », *Marine Pollution Bulletin*, vol. 103, n° 1-2, p. 344-348, févr. 2016, doi: 10.1016/j.marpolbul.2015.12.036.
- [66] Y. Pico *et al.*, « Contaminants of emerging concern in freshwater fish from four Spanish Rivers », *Science of The Total Environment*, vol. 659, p. 1186-1198, avr. 2019, doi: 10.1016/j.scitotenv.2018.12.366.
- [67] R. Sutton, D. Chen, J. Sun, D. J. Greig, et Y. Wu, « Characterization of brominated, chlorinated, and phosphate flame retardants in San Francisco Bay, an urban estuary », *Science of The Total Environment*, vol. 652, p. 212-223, févr. 2019, doi: 10.1016/j.scitotenv.2018.10.096.
- [68] M. J. La Guardia, R. C. Hale, et B. Newman, « Brominated Flame-Retardants in Sub-Saharan Africa: Burdens in Inland and Coastal Sediments in the eThekweni Metropolitan Municipality, South Africa », *Environ. Sci. Technol.*, vol. 47, n° 17, p. 9643-9650, sept. 2013, doi: 10.1021/es4020212.
- [69] Z.-W. Zhang *et al.*, « Brominated flame retardants in mangrove sediments of the Pearl River Estuary, South China: Spatial distribution, temporal trend and mass inventory », *Chemosphere*, vol. 123, p. 26-32, mars 2015, doi: 10.1016/j.chemosphere.2014.11.042.
- [70] L. Tao *et al.*, « Biomagnification of PBDEs and alternative brominated flame retardants in a predatory fish: Using fatty acid signature as a primer », *Environment International*, vol. 127, p. 226-232, juin 2019, doi: 10.1016/j.envint.2019.03.036.
- [71] L. Mo, J. Wu, X. Luo, F. Zou, et B. Mai, « Bioaccumulation of polybrominated diphenyl ethers, decabromodiphenyl ethane, and 1,2-bis(2,4,6-tribromophenoxy) ethane flame retardants in kingfishers (*Alcedo atthis*) from an electronic waste-recycling site in South China », *Enviro Toxic and Chemistry*, vol. 31, n° 9, p. 2153-2158, sept. 2012, doi: 10.1002/etc.1929.
- [72] A. C. Rocha *et al.*, « Bioaccumulation of persistent and emerging pollutants in wild sea urchin *Paracentrotus lividus* », *Environmental Research*, vol. 161, p. 354-363, févr. 2018, doi: 10.1016/j.envres.2017.11.029.
- [73] B. Zhang, H. Li, Y. Wei, et J. You, « Bioaccumulation kinetics of polybrominated diphenyl ethers and decabromodiphenyl ethane from field-collected sediment in the oligochaete, *Lumbriculus variegatus* », *Enviro Toxic and Chemistry*, vol. 32, n° 12, p. 2711-2718, déc. 2013, doi: 10.1002/etc.2384.
- [74] Y.-X. Sun *et al.*, « Bioaccumulation and biomagnification of halogenated organic pollutants in mangrove biota from the Pearl River Estuary, South China », *Marine Pollution Bulletin*, vol. 99, n° 1-2, p. 150-156, oct. 2015, doi: 10.1016/j.marpolbul.2015.07.041.
- [75] J. Cristale, A. Katsoyiannis, C. Chen, K. C. Jones, et S. Lacorte, « Assessment of flame retardants in river water using a ceramic dosimeter passive sampler », *Environmental Pollution*, vol. 172, p. 163-169, janv. 2013, doi: 10.1016/j.envpol.2012.08.014.

- [76] D. Geng, P. Kukucka, et I. E. Jogsten, « Analysis of brominated flame retardants and their derivatives by atmospheric pressure chemical ionization using gas chromatography coupled to tandem quadrupole mass spectrometry », *Talanta*, vol. 162, p. 618-624, janv. 2017, doi: 10.1016/j.talanta.2016.10.060.
- [77] R. Sun, C. Pan, F. Peng, Y. Wu, X. Chen, et B. Mai, « Alternative halogenated flame retardants (AHFRs) in green mussels from the south China sea », *Environmental Research*, vol. 182, p. 109082, mars 2020, doi: 10.1016/j.envres.2019.109082.
- [78] S. L. Klosterhaus, H. M. Stapleton, M. J. La Guardia, et D. J. Greig, « Brominated and chlorinated flame retardants in San Francisco Bay sediments and wildlife », *Environment International*, vol. 47, p. 56-65, oct. 2012, doi: 10.1016/j.envint.2012.06.005.
- [79] R. Yang, H. Wei, J. Guo, et A. Li, « Emerging Brominated Flame Retardants in the Sediment of the Great Lakes », *Environ. Sci. Technol.*, vol. 46, n° 6, p. 3119-3126, mars 2012, doi: 10.1021/es204141p.
- [80] T. Isobe, S. P. Ogawa, K. Ramu, A. Sudaryanto, et S. Tanabe, « Geographical distribution of non-PBDE-brominated flame retardants in mussels from Asian coastal waters », *Environ Sci Pollut Res*, vol. 19, n° 8, p. 3107-3117, sept. 2012, doi: 10.1007/s11356-012-0945-6.
- [81] E. Barón *et al.*, « Halogenated Natural Products in Dolphins: Brain–Blubber Distribution and Comparison with Halogenated Flame Retardants », *Environ. Sci. Technol.*, vol. 49, n° 15, p. 9073-9083, août 2015, doi: 10.1021/acs.est.5b02736.
- [82] H. Marler, J. Xie, D. H. Adams, C. K. Nielsen, Y. Wu, et D. Chen, « Legacy and emerging flame retardants in sharks from the Western North Atlantic Ocean », *Science of The Total Environment*, vol. 829, p. 154330, juill. 2022, doi: 10.1016/j.scitotenv.2022.154330.
- [83] R.-X. Sun, X.-J. Luo, X.-X. Tan, B. Tang, Z.-R. Li, et B.-X. Mai, « Legacy and emerging halogenated organic pollutants in marine organisms from the Pearl River Estuary, South China », *Chemosphere*, vol. 139, p. 565-571, nov. 2015, doi: 10.1016/j.chemosphere.2015.07.044.
- [84] M. B. Alonso *et al.*, « Natural and anthropogenically-produced brominated compounds in endemic dolphins from Western South Atlantic: Another risk to a vulnerable species », *Environmental Pollution*, vol. 170, p. 152-160, nov. 2012, doi: 10.1016/j.envpol.2012.06.001.
- [85] M. Houde, D. Berryman, Y. De Lafontaine, et J. Verreault, « Novel brominated flame retardants and dechloranes in three fish species from the St. Lawrence River, Canada », *Science of The Total Environment*, vol. 479-480, p. 48-56, mai 2014, doi: 10.1016/j.scitotenv.2014.01.105.
- [86] E. Barón, I. Rudolph, G. Chiang, R. Barra, E. Eljarrat, et D. Barceló, « Occurrence and behavior of natural and anthropogenic (emerging and historical) halogenated compounds in marine biota from the Coast of Concepcion (Chile) », *Science of The Total Environment*, vol. 461-462, p. 258-264, sept. 2013, doi: 10.1016/j.scitotenv.2013.05.006.
- [87] J. Cristale, A. Katsoyiannis, A. J. Sweetman, K. C. Jones, et S. Lacorte, « Occurrence and risk assessment of organophosphorus and brominated flame retardants in the River Aire (UK) », *Environmental Pollution*, vol. 179, p. 194-200, août 2013, doi: 10.1016/j.envpol.2013.04.001.
- [88] G. Poma, C. Roscioli, et L. Guzzella, « PBDE, HBCD, and novel brominated flame retardant contamination in sediments from Lake Maggiore (Northern Italy) », *Environ Monit Assess*, vol. 186, n° 11, p. 7683-7692, nov. 2014, doi: 10.1007/s10661-014-3959-3.
- [89] S. Lee, K. Ra, et H.-B. Moon, « Severe contamination and time trends of legacy and novel halogenated flame retardants in multiple environmental media from Lake Shihwa, Korea: Effectiveness of regulatory action », *Chemosphere*, vol. 279, p. 130620, sept. 2021, doi: 10.1016/j.chemosphere.2021.130620.
- [90] Y. Wu *et al.*, « Spatial and Temporal Trends (2004–2016) of Selected Alternative Flame Retardants in Fish of the Laurentian Great Lakes », *Environ. Sci. Technol.*, vol. 53, n° 4, p. 1786-1796, févr. 2019, doi: 10.1021/acs.est.8b05300.

- [91] M. Houde *et al.*, « Spatial and temporal trends of alternative flame retardants and polybrominated diphenyl ethers in ringed seals (*Phoca hispida*) across the Canadian Arctic », *Environmental Pollution*, vol. 223, p. 266-276, avr. 2017, doi: 10.1016/j.envpol.2017.01.023.
- [92] M. Widelka, M. J. Lydy, Y. Wu, et D. Chen, « Statewide surveillance of halogenated flame retardants in fish in Illinois, USA », *Environmental Pollution*, vol. 214, p. 627-634, juill. 2016, doi: 10.1016/j.envpol.2016.04.063.
- [93] Ò. Aznar-Alemany *et al.*, « Temporal trends of halogenated and organophosphate contaminants in striped dolphins from the Mediterranean Sea », *Science of The Total Environment*, vol. 753, p. 142205, janv. 2021, doi: 10.1016/j.scitotenv.2020.142205.
- [94] Y. Wang *et al.*, « Temporal trends of novel brominated flame retardants in mollusks from the Chinese Bohai Sea (2011–2018) », *Science of The Total Environment*, vol. 777, p. 146101, juill. 2021, doi: 10.1016/j.scitotenv.2021.146101.
- [95] A. E. Simond, M. Houde, V. Lesage, et J. Verreault, « Temporal trends of PBDEs and emerging flame retardants in belugas from the St. Lawrence Estuary (Canada) and comparisons with minke whales and Canadian Arctic belugas », *Environmental Research*, vol. 156, p. 494-504, juill. 2017, doi: 10.1016/j.envres.2017.03.058.
- [96] G. Zheng *et al.*, « Trophodynamics of Emerging Brominated Flame Retardants in the Aquatic Food Web of Lake Taihu: Relationship with Organism Metabolism across Trophic Levels », *Environ. Sci. Technol.*, vol. 52, n° 8, p. 4632-4640, avr. 2018, doi: 10.1021/acs.est.7b06588.
- [97] J.-P. Wu *et al.*, « Trophodynamics of Hexabromocyclododecanes and Several Other Non-PBDE Brominated Flame Retardants in a Freshwater Food Web », *Environ. Sci. Technol.*, vol. 44, n° 14, p. 5490-5495, juill. 2010, doi: 10.1021/es101300t.
- [98] Y. Liu *et al.*, « Brominated flame retardants (BFRs) in marine food webs from Bohai Sea, China », *Science of The Total Environment*, vol. 772, p. 145036, juin 2021, doi: 10.1016/j.scitotenv.2021.145036.
- [99] J. Sobotka, G. Lammel, J. Slobodník, A. Schink, R. Prokeš, et B. Vrana, « Dynamic passive sampling of hydrophobic organic compounds in surface seawater along the South Atlantic Ocean east-to-west transect and across the Black Sea », *Marine Pollution Bulletin*, vol. 168, p. 112375, juill. 2021, doi: 10.1016/j.marpolbul.2021.112375.
- [100] L. Liu, X. Zhen, X. Wang, Y. Li, X. Sun, et J. Tang, « Legacy and novel halogenated flame retardants in seawater and atmosphere of the Bohai Sea: Spatial trends, seasonal variations, and influencing factors », *Water Research*, vol. 184, p. 116117, oct. 2020, doi: 10.1016/j.watres.2020.116117.
- [101] Y. Sapozhnikova et S. J. Lehotay, « Multi-class, multi-residue analysis of pesticides, polychlorinated biphenyls, polycyclic aromatic hydrocarbons, polybrominated diphenyl ethers and novel flame retardants in fish using fast, low-pressure gas chromatography–tandem mass spectrometry », *Analytica Chimica Acta*, vol. 758, p. 80-92, janv. 2013, doi: 10.1016/j.aca.2012.10.034.
- [102] F. Xu, Á. García-Bermejo, G. Malarvannan, B. Gómara, H. Neels, et A. Covaci, « Multi-contaminant analysis of organophosphate and halogenated flame retardants in food matrices using ultrasonication and vacuum assisted extraction, multi-stage cleanup and gas chromatography–mass spectrometry », *Journal of Chromatography A*, vol. 1401, p. 33-41, juill. 2015, doi: 10.1016/j.chroma.2015.05.001.
- [103] A. Möller, Z. Xie, A. Caba, R. Sturm, et R. Ebinghaus, « Occurrence and air-seawater exchange of brominated flame retardants and Dechlorane Plus in the North Sea », *Atmospheric Environment*, vol. 46, p. 346-353, janv. 2012, doi: 10.1016/j.atmosenv.2011.09.055.
- [104] M. Venier, A. Dove, K. Romanak, S. Backus, et R. Hites, « Flame Retardants and Legacy Chemicals in Great Lakes' Water », *Environ. Sci. Technol.*, vol. 48, n° 16, p. 9563-9572, août 2014, doi: 10.1021/es501509r.
- [105] R. Sühring *et al.*, « Brominated flame retardants and Dechloranes in European and American eels from glass to silver life stages », *Chemosphere*, vol. 116, p. 104-111, déc. 2014, doi: 10.1016/j.chemosphere.2013.10.096.

- [106] R. Sühring *et al.*, « Brominated flame retardants and dechloranes in eels from German Rivers », *Chemosphere*, vol. 90, n° 1, p. 118-124, janv. 2013, doi: 10.1016/j.chemosphere.2012.08.016.
- [107] P. B. Kurt-Karakus *et al.*, « Bioaccumulation of Selected Halogenated Organic Flame Retardants in Lake Ontario », *Environ Toxicol Chem*, vol. 38, n° 6, p. 1198-1210, juin 2019, doi: 10.1002/etc.4413.
- [108] R. J. Law *et al.*, « Alternative flame retardants, Dechlorane Plus and BDEs in the blubber of harbour porpoises (*Phocoena phocoena*) stranded or bycaught in the UK during 2008 », *Environment International*, vol. 60, p. 81-88, oct. 2013, doi: 10.1016/j.envint.2013.08.009.
- [109] A. Strid, C. Bruhn, E. Sverko, J. Svavarsson, G. Tomy, et Å. Bergman, « Brominated and chlorinated flame retardants in liver of Greenland shark (*Somniosus microcephalus*) », *Chemosphere*, vol. 91, n° 2, p. 222-228, avr. 2013, doi: 10.1016/j.chemosphere.2012.12.059.
- [110] J. Ma, X. Li, S. Ma, X. Zhang, G. Li, et Y. Yu, « Temporal trends of “old” and “new” persistent halogenated organic pollutants in fish from the third largest freshwater lake in China during 2011–2018 and the associated health risks », *Environmental Pollution*, vol. 267, p. 115497, déc. 2020, doi: 10.1016/j.envpol.2020.115497.
- [111] H. Wolschke, X.-Z. Meng, Z. Xie, R. Ebinghaus, et M. Cai, « Novel flame retardants (N-FRs), polybrominated diphenyl ethers (PBDEs) and dioxin-like polychlorinated biphenyls (DL-PCBs) in fish, penguin, and skua from King George Island, Antarctica », *Marine Pollution Bulletin*, vol. 96, n° 1-2, p. 513-518, juill. 2015, doi: 10.1016/j.marpolbul.2015.04.012.
- [112] Y. Wang *et al.*, « Characterization of PBDEs and novel brominated flame retardants in seawater near a coastal mariculture area of the Bohai Sea, China », *Science of The Total Environment*, vol. 580, p. 1446-1452, févr. 2017, doi: 10.1016/j.scitotenv.2016.12.114.
- [113] H. Zhang, S. Bayen, et B. C. Kelly, « Multi-residue analysis of legacy POPs and emerging organic contaminants in Singapore’s coastal waters using gas chromatography–triple quadrupole tandem mass spectrometry », *Science of The Total Environment*, vol. 523, p. 219-232, août 2015, doi: 10.1016/j.scitotenv.2015.04.012.
- [114] M. L. Maia, C. Delerue-Matos, C. Calhau, et V. F. Domingues, « Validation and Evaluation of Selected Organic Pollutants in Shrimp and Seawater Samples from the NW Portuguese Coast », *Molecules*, vol. 26, n° 19, p. 5774, sept. 2021, doi: 10.3390/molecules26195774.
- [115] N. Zhu *et al.*, « Tris(2,3-dibromopropyl) Isocyanurate, Hexabromocyclododecanes, and Polybrominated Diphenyl Ethers in Mollusks from Chinese Bohai Sea », *Environ. Sci. Technol.*, vol. 46, n° 13, p. 7174-7181, juill. 2012, doi: 10.1021/es300776f.
- [116] C. Andvik, E. Jourdain, J. L. Lyche, R. Karoliussen, et K. Borgå, « High Levels of Legacy and Emerging Contaminants in Killer Whales (*Orcinus orca*) from Norway, 2015 to 2017 », *Enviro Toxic and Chemistry*, vol. 40, n° 7, p. 1848-1858, juill. 2021, doi: 10.1002/etc.5064.
- [117] L. Wang, Q. Zhao, Y. Zhao, M. Zheng, Y. Lou, et B. Yang, « New non-PBDE brominated flame retardants in sediment and plant samples from Jiaozhou Bay wetland », *Marine Pollution Bulletin*, vol. 97, n° 1-2, p. 512-517, août 2015, doi: 10.1016/j.marpolbul.2015.05.026.
- [118] S. Vauclin *et al.*, « Temporal trends of legacy and novel brominated flame retardants in sediments along the Rhône River corridor in France », *Chemosphere*, vol. 271, p. 129889, mai 2021, doi: 10.1016/j.chemosphere.2021.129889.
- [119] R.-X. Sun, X.-J. Luo, X.-X. Tan, B. Tang, Z.-R. Li, et B.-X. Mai, « An eight year (2005–2013) temporal trend of halogenated organic pollutants in fish from the Pearl River Estuary, South China », *Marine Pollution Bulletin*, vol. 93, n° 1-2, p. 61-67, avr. 2015, doi: 10.1016/j.marpolbul.2015.02.014.
- [120] L. Trouborst, S. Chu, D. Chen, et R. J. Letcher, « Methodology and determination of tetradecabromo-1,4-diphenoxybenzene flame retardant and breakdown by-products in sediments from the Laurentian Great Lakes », *Chemosphere*, vol. 118, p. 342-349, janv. 2015, doi: 10.1016/j.chemosphere.2014.09.092.

- [121] X. Chi, J. Liu, M. Yu, Z. Xie, et G. Jiang, « Analysis of bromophenols in various aqueous samples using solid phase extraction followed by HPLC-MS/MS », *Talanta*, vol. 164, p. 57-63, mars 2017, doi: 10.1016/j.talanta.2016.11.010.
- [122] Y. Ruan, X. Zhang, J.-W. Qiu, K. M. Y. Leung, J. C. W. Lam, et P. K. S. Lam, « Stereoisomer-Specific Trophodynamics of the Chiral Brominated Flame Retardants HBCD and TBEC in a Marine Food Web, with Implications for Human Exposure », *Environ. Sci. Technol.*, vol. 52, n° 15, p. 8183-8193, août 2018, doi: 10.1021/acs.est.8b02206.
- [123] Y. Ruan, J. C. W. Lam, X. Zhang, et P. K. S. Lam, « Temporal Changes and Stereoisomeric Compositions of 1,2,5,6,9,10-Hexabromocyclododecane and 1,2-Dibromo-4-(1,2-dibromoethyl)cyclohexane in Marine Mammals from the South China Sea », *Environ. Sci. Technol.*, vol. 52, n° 5, p. 2517-2526, mars 2018, doi: 10.1021/acs.est.7b05387.
- [124] A. Liu *et al.*, « Characterization of Three Tetrabromobisphenol-S Derivatives in Mollusks from Chinese Bohai Sea: A Strategy for Novel Brominated Contaminants Identification », *Sci Rep*, vol. 5, n° 1, p. 11741, juill. 2015, doi: 10.1038/srep11741.
- [125] S. Samanipour, P. Dimitriou-Christidis, D. Nabi, et J. S. Arey, « Elevated Concentrations of 4-Bromobiphenyl and 1,3,5-Tribromobenzene Found in Deep Water of Lake Geneva Based on GC×GC-ENCI-TOFMS and GC×GC-μECD », *ACS Omega*, vol. 2, n° 2, p. 641-652, févr. 2017, doi: 10.1021/acsomega.6b00440.
- [126] Å. Bergman *et al.*, « A novel abbreviation standard for organobromine, organochlorine and organophosphorus flame retardants and some characteristics of the chemicals », *Environment International*, vol. 49, p. 57-82, nov. 2012, doi: 10.1016/j.envint.2012.08.003.
- [127] Y. Liu *et al.*, « Brominated flame retardants (BFRs) in marine food webs from Bohai Sea, China », *Science of The Total Environment*, vol. 772, p. 145036, juin 2021, doi: 10.1016/j.scitotenv.2021.145036.