Supporting Information

Global Environmental and Toxicological Data of Emerging Plasticizers: Current Knowledge, Regrettable Substitution Dilemma, Green Solution and Future Perspectives

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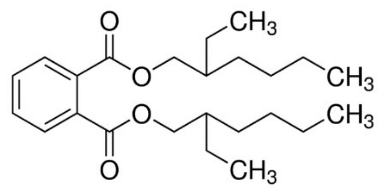
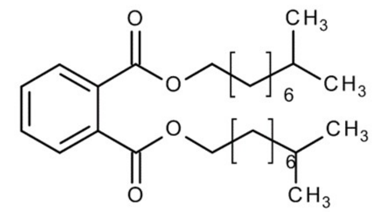
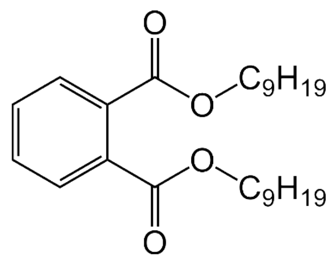
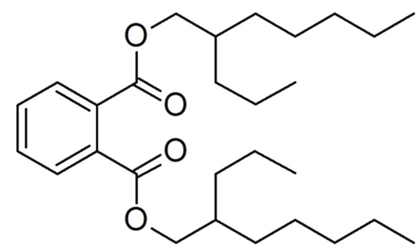
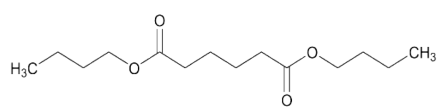
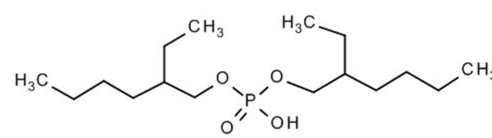
Table S1. Names, abbreviations, and basic properties of phthalates and alternative/emerging plasticizers

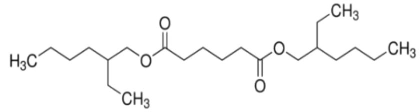
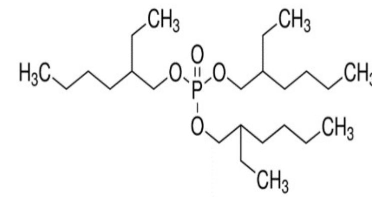
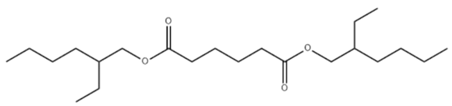
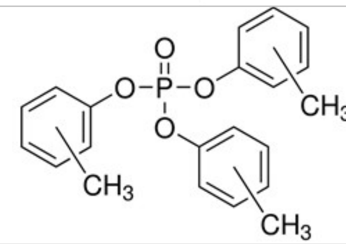
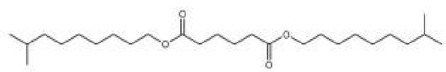
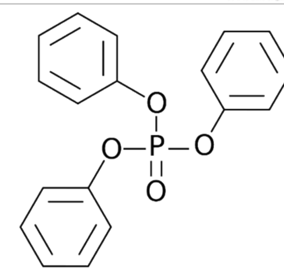
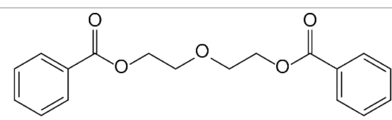
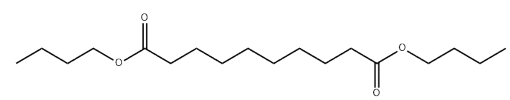
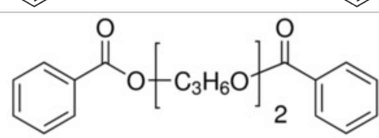
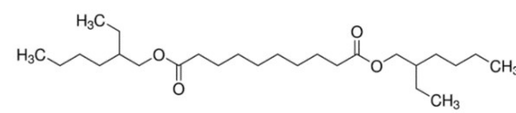
Name	Abbreviation	Molecular formula	Molecular weight	log Kow (at 25 °C)
Phthalate plasticizers				
Bis-2-ethylhexyl phthalate	DEHP	$C_{24}H_{38}O_4$	390.6	7.5
Diisononyl phthalate	DINP	$C_{26}H_{42}O_4$	418.6	9.5
Diisodecyl phthalate	DIDP	$C_{28}H_{46}O_4$	446.7	9.5
Bis(2-propylheptyl) phthalate	DPHP	$C_{28}H_{46}O_4$	446.7	10.4
Alternative Plasticizers				
(a) Adipates				
Dibutyl adipate	DBA	$C_{14}H_{26}O_4$	258.3	4.3
Bis 2-ethylhexyl adipate	DEHA	$C_{22}H_{42}O_4$	370.6	8.9
Diisononyl adipate	DINA	$C_{24}H_{46}O_4$	398.6	9.2
Diisodecyl adipate	DIDA	$C_{26}H_{50}O_4$	426.67	10.1
(b) Benzoates				
Diethylene glycol dibenzoate	DEGDB	$C_{18}H_{18}O_5$	314.3	3.0
Dipropylene Glycol Dibenzoate	DPGDB	$C_{20}H_{22}O_5$	342.4	4.3
(c) Citrates				
Acetyl tributyl citrate	ATBC	$C_{20}H_{34}O_8$	402.5	4.3
(d) Cyclohexane dicarboxylic acids				
Diisononyl cyclohexane-1,2 dicarboxylate	DINCH	$C_{26}H_{48}O_4$	424.7	10
(e) Phosphate esters				

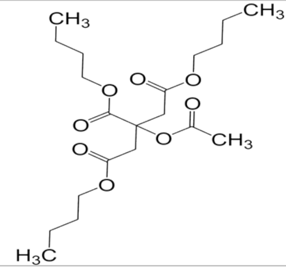
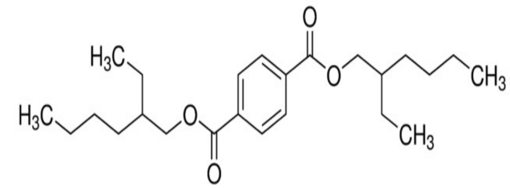
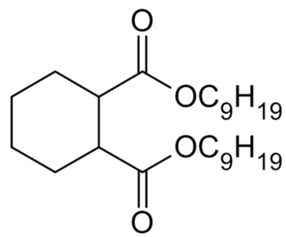
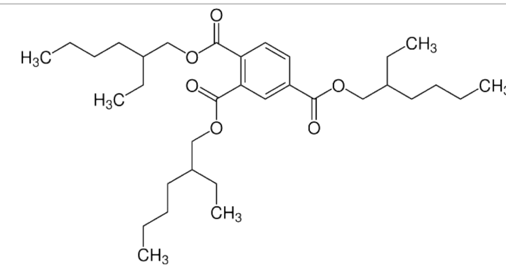
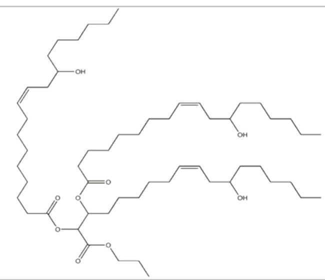
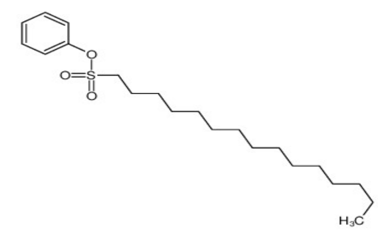
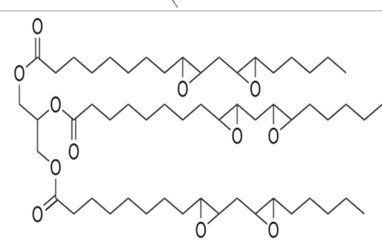
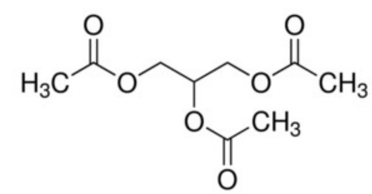
Bis 2-ethylhexyl phosphate	HDEHP	$C_{16}H_{35}O_4P$	322.42	2.7
Tris-2-ethylhexyl phosphate	TEHP	$C_{24}H_{51}O_4P$	434.63	9.5
Tricresyl phosphate	TCP	$C_{21}H_{21}O_4P$	368.4	5.1
Triphenyl phosphate	TPHP (TPP)	$C_{18}H_{15}O_4P$	326.3	4.59
(f) Sebacates				
Dibutyl sebacate	DBS	$C_{18}H_{34}O_4$	314.5	6.3
Bis-2-ethylhexyl sebacate	DOS	$C_{26}H_{50}O_4$	426.7	10.1
(g) Terephthalates				
Bis- 2-ethylhexyl terephthalate	DEHT	$C_{24}H_{38}O_4$	390.56	8.4
(h) Trimellitates				
Tris-2-ethylhexyl trimellitate	TOTM	$C_{33}H_{54}O_6$	546.78	8
f) Vegetable oil derivatives				
Castor-oil-mono-hydrogenated acetate	COMGHA		500.5	6.4
Epoxidized soybean oil	ESBO	$C_{57}H_{98}O_{12}$	1000.00	14.8
(i) Others				
Alkylsulfonic phenyl ester	ASE	N.F	368.6	3.9
Glycerin triacetate	GTA	$C_9H_{14}O_6$	218.2	0.3
Trimethyl pentanyl diisobutyrate	TXIB	$C_{16}H_{30}O_4$	286.4	4.9

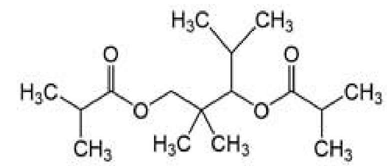
Data was acquired from TOXNET-chemistry database (https://toxnet.nlm.nih.gov/newtoxnet/hsdb.htm)

Table S2. Structures of the phthalate and alternative plasticizers

Names	**Structures**	**Names**	**Structures**
Phthalate plasticizers			
DEHP		DIDP	
DINP		DPHP	
Alternative Plasticizers			
Adipates		Phosphate esters	
DBA		DEHPA	

DEHA		TEHPA	
DINA		TCP	
DIDA		TPHP	
Benzoates		Sebacates	
DEGDB		DBS	
DPGDB		DOS	
Citrates		Terephthalates	

ATBC		DEHT	
Cyclohexane dicarboxylic acids		Trimellitates	
DINCH		TOTM	
Vegetable oil derivatives		Miscellaneous	
COMGHA		ASE	
ESBO		GTA	

		TXIB	

Structures were taken from chemistry database TOXNET

Table S3. Data of toxicity, exposure, and environment monitoring of plasticizers

Name	Abbreviations	Toxicological information	Environmental monitoring/exposure	General status of toxicity, exposure and environmental monitoring
Phthalate plasticizers				**Generally, data is available** [1,2,11–16,3–10]
Alternative plasticizers				**Generally, lacking data**
(a) Adipates				
Dibutyl adipate	DBA	No data	Concentration (104-839 ug/g) detected in the dust of children's homes [17].	**No data available** -No toxicological studies -No ecological studies -One study of environmental monitoring
Bis 2-ethylhexyl adipate	DEHA	Endocrine disruption potential in fish [18]. DNA damage in fish [19]. Impairment of the sex steroid homeostasis [20]. Metabolite of DEHA was found to be cytotoxic [21]. Potential carcinogenic and very toxic to aquatic organisms (https://www.cdc.gov/niosh/index.htm). DEHA exposure can lead to fetal death and reduced pregnancies [22].	Traces found in food and breast milk.[23–25]. Daily DEHA intake was 12.5 µg/day in diet [26]. Traces were found in dust samples of China (max 1520 ng/g) [1]. Kuwait Marine water were found to have 0.06–0.13 µg/L concentration [27]. Swedish preschool dust concentrations were 8.5 µg/g [28].	**Limited data available** -Limited toxicological studies -No ecological studies -Limited Environmental monitoring studies
Diisononyl adipate	DINA	Potential embryotoxic and disrupts thyroid hormone activity in fish [29]. But according to the Danish Environmental Protection Agency's (DEPA) old report, it is readily biodegradable, no reproductive and developmental toxicity is noticed [30].	Hospital meals with an estimated daily intake of up to 4.7 µg/day[26]. Concentrations were not detected in retail food.[31]	**No data available** -One toxicological study (also, Danish Environmental Agency report is available) -No ecological studies

				-One environmental monitoring studies
Diisodecyl adipate	DIDA	No Data	Residues (20 ug/l) of DIDA were found in breast milk [25]	**No data available** -No toxicological studies -No ecological risks studies -No environmental monitoring study (one break milk concentrations available)
(b) Benzoates				
Diethylene glycol dibenzoate	DEGDB	Possible impairment of lipid metabolism.[32] Potential impact on reproductive health.[30]	No Data	**No data available** -Limited toxicological studies (old reports) -No Ecological studies -No environmental monitoring studies
Dipropylene Glycol Dibenzoate	DPGDB	Low toxicity and no mutagenic effect, according to one old report [33] Potential impact on reproductive health [30]	No Data	**No data available** -Limited toxicological studies (old reports) -No ecological studies -No environmental monitoring studies
(c) Citrates				
Acetyl tributyl citrate	ATBC	Abnormal embryo development and disrupted thyroid hormone activity in fish[34]. Potential thyroid hormone disruption in thyroid hormone receptor test [35]. Potential impairment of sex steroid homeostasis [20] Potential detrimental to normal ovarian function in mice.[36,37]	In global water bodies concentrations were o.05μg/L in the marine environment of Kuwait [27] , <LOQ to 96 ng/L in Nakdong River of Korea [38], 154 μg/L in groundwater of England [39], and ≤ 0.54 in Rur River of Germany[40].Dermal bioaccessibility of ATBC was 75.02 ± 2.12% in house dust [37].	**Limited data available** -Few toxicological studies -No ecological studies -Few environmental monitoring studies (few reports indicating their high levels in water bodies around the world)

			Concentrations were found in retail food [31]. High concentrations were found in the home dust of China (max 37,270 ng/g) [1].	
(d) Cyclohexane dicarboxylic acids				
Diisononyl cyclohexane-1,2 dicarboxylate	DINCH	Potential physiological and metabolic toxicity in fish [41]. Potential for thyroid hormone disruption in thyroid hormone receptor test [35]. DINCH exposure could impact testosterone levels in humans [42,43]. In vitro study revealed that DINCH can cause cytotoxicity in kidney cells and DNA damage to liver cells [44]. Impairment of metabolic function reduced testosterone levels and damage of the testis in rats [45]. Potential endocrine disrupter in silico study [46]. Cytotoxic properties in vitro study.[21] Although considered as non/least toxic by ECHA (2014).	DINCH metabolites (OH-MINCH, cx-MINCH, oxo-MINCH)were found in US population [47], Norway population [48], and German population [49]. Residues of DINCH were found in German house dust upto110 mg/kg [50]. High levels of residues (ranging 1,060 to 11,550 ng/g) were found in dust samples of China [1].	**Limited data available** -Few toxicological studies -No ecological studies -Few environmental monitoring studies
E) Phosphate esters		Generally, data is available on toxicity. Conflicting studies on bioaccumulation and biomagnification [51–56]. phosphate esters could cause carcinogenicity, teratogenicity, reproductive issues, and developmental toxicity [53,57–62].	Environmental monitoring worldwide [62–70].	
Bis 2-ethylhexyl phosphate	HDEHP	Potentially can cause irritation and headache. Ecosystem toxicity data indicated it has potential harms to algae, fish, and crustaceans.[71] Potential bioaccumulative substance [71].	Median concentrations were 654 ng/g and 867 ng/g for China and mid-western US dust, respectively [65]. The average concentrations in China were 75 and 31.9 ng/g dw, for Indoor and outdoor dust respectively [72].	**Limited data available** -Limited toxicological studies -No ecological studies -Few environmental monitoring studies

Tris-2-ethylhexyl phosphate	TEHP	Potential endocrine disrupter [25,73]. Potential toxicity for *Daphnia magna* [74].	Concentrations in Portugal house dust ranged from 250 to 23,000 ng/g [63]. Levels in Swedish preschools dust were 0.44µg/g[28].	**Data available** -limited toxicological studies -No ecological studies -Few environmental monitoring studies
Tricresyl phosphate	TCP	Exposure of TCP is associated with increased levels of cholesterol and plasma of triglyceride of humans [75]. Potential reproductive toxicant [25]. Potential neurotoxicity, intestinal damage, and DNA damage in earthworms [58].	High concentrations ranging from 110 to 5200 ng/g were found in house dust [63]. Levels were 0.98 µg/g in Swedish house dust [28].	**Data available** -Few toxicological studies -Few ecological studies -Few environmental monitoring studies
Triphenyl phosphate	TPHP	Exposure to TPHP is associated with increase cholesterol and plasma levels of triglyceride in humans [75]. Acute toxicity was found to be increased due to the joint effect of TPHP and tributyl phosphate [74]. Potential endocrine disruptor in aquatic organisms and humans [61,76–81]. Only recently, TPHP has been identified as an endocrine disruptor [61,76–81].	Concentrations were ranged from 110 to 5200 ng/g with 100 percent detection frequency in 28 dust samples of Portugal houses [63]. Average concentrations were 206 and 69.5 ng/g for Indoor and outdoor dust of China, respectively [72].	**Data available** -Limited toxicological studies -Few ecological studies -Few environmental monitoring studies
(e) Sebacates				
Dibutyl sebacate	DBS	No Data	In an old study, concentrations were not detected in Japanese retail food [31].Traces found in polyvinylidene chloride (PVDC) wrapping films [82]. high concentrations of DBS (median 3390 ng/g) in face masks [83]. Likely to found in medicine coating [84].	**No data available** -No toxicological studies -No ecological studies - limited environmental monitoring studies

Bis-2-ethylhexyl sebacate	DOS	Potentially disrupt thyroid hormone metabolism in fish [85].	DOS (median 352 ng/g) were found in single-use face masks [83].	**Limited data available** -One toxicological study -No ecological studies -No environmental monitoring studies
(f) Terephthalates				
Bis- 2-ethylhexyl terephthalate	DEHT	Bioaccumulation and toxicity in mussels DEHT [86]. Disruptions of post-delivery metabolic health [87]. Potential oxidative stress in an exposed Sertoli cell line [88]. Metabolites were found in adults, nail technicians of USA [89,90], and Portuguese children [91]. Old reports indicated there are no carcinogenic, mutagenic, and developmental defects associated with DEHT.[25,92,93] However, latest investigation is indicating otherwise [93]. Potential endocrine disrupter according to in silico study [46].	Metabolites of DEHT were quantified in 2970 urine samples of USA adults from 2015 to 2016 [90]. DEHT concentrations were detected in Portuguese children [91]. Concentrations of DEHT (440 mg/kg) were found in dust samples collected from German indoor environments [50].	**Data available** - Few toxicological studies -Few ecological studies - Few environmental monitoring studies
(g) Trimellitates				
Tris-2-ethylhexyl trimellitate	TOTM	Human biomonitoring (2014-2017) indicated that children and adolescents had exposure to TOTM.[94] TOTM can cause a low resorption rate and slow metabolism.[95] TOTM exposure can cause estrogen activity and cells[96]. In	High levels of concentrations were found in the dust sample of China, ranging from 404-101,250 ng/g [1]. TOTM was a dominant compound in the sediments of industrialized bays of Korea [100].	**Limited data available** - Few toxicological studies - No ecological studies - Few environmental monitoring studies

		one experiment on mice, exposure to TOTM lead to alternation in cell cycle, oxidative toxicity, and lipid metabolism.[97] Potential endocrine disrupter according to in silico study[46]. changes in estrogen activity and cell toxicity in human leukemia and cell assays [96]. Disruption in cell cycle, oxidative stress, and metabolism of lipids in mice [97]. European chemical regulations identify TOTM as the first non-phthalate plasticizer for its potential endocrine disruption, bioaccumulation, and toxic (PBT) properties [98,99].		
Vegetable oil derivatives				
Castor-oil-mono-, hydrogenated, acetate	COMGHA	According to ECHA, it is non-hazardous [101].	No Data	**No data available** - No toxicological studies (one old report) - No ecological studies - No environmental monitoring studies
Epoxidized soybean oil	ESBO	British Industrial Biological Research Association (BBIRA) announced ESBO as a low acute toxicant to rats and rabbits [102]. European Chemicals Agency deems ESBO a safe option due to the absence of hazardous properties [101,103,104].	ESBO ranging from 6 to 100 mg/kg were found in the seven Danish food samples [105]. According to Swiss market survey, ESBO was dominant plasticizer with concentration reached 1,170 mg/g in 158 samples [106]. These values were much higher than migration limit (60mg/kg) set by the European Food Safety Authority [107,108].	**Limited data available** - Limited toxicological studies (Old reports) - No ecological studies - Few environmental monitoring studies
(h) Others				
Alkylsulfonic phenyl ester	ASE	Danish Environment Protection Agency reports that ASE exposure was linked to	Elbe river and its tributaries were found to have concentrations from 15	**Limited data available**

		low acute toxicity [109]	ug/kg to 33000 ug/kg in sediments.[110] Traces were found in multiple samples of dust and sediments [111,112].	- No toxicological studies (old report) - No ecological studies - Few environmental monitoring studies
Glycerin triacetate	GTA	According to US-FDA guidelines, it is generally accepted as safe (GRAS) [113]. No developmental toxicity, carcinogenic effects, and reproductive toxicity effects were found despite lack of quality information [30,113,114].	No Data	**Limited data available** - Limited toxicological studies - No ecological studies - No environmental monitoring studies
Trimethyl pentanyl diisobutyrate	TXIB	There are only limited studies (especially peer-reviewed) but also contradictory. In a study involving 203 the repeated application of TXIB did not result in skin sensitization [115]. May cause minor irritation of the eye and nasal mucosa [116]. DEPA states that a 13-week dosing of TXIB in dogs did not lead to harmful effects [30]. When administered orally to rats and rabbits, TXIB demonstrated low acute toxicity, and slight skin irritation in guinea pigs, with no such irritation observed in rabbits [30]. These findings suggest either no toxicity or relatively minimal toxicity. The European Chemical Agency has expressed concerns regarding the potential impact of TXIB on fertility, the developing fetus, and aquatic life with long-lasting effects [117] There are some chances that this compound can be a risk factor of asthma and sick building syndrome [118,119]. Adaptive changes in liver due to exposure of TXIB which	Sweden schools' indoor and outdoor concentrations were 1.64 µg/m3 and 0.41 $\mu g/m^3$, respectively [121].	**Limited data available** - Limited toxicological studies (old and contradictory reports) - No ecological studies - One environmental monitoring study

	were reversible [120]. Further studies needed.	

*Please note due to limited space in the table, it is recommended to read whole article for complete and updated information.

Table S4. Urinary excretion factors (F_{ue}) as DEHTP dose equivalents in %; mean values of three volunteers, ranges in brackets. Data is from[122]

	5OH-MEHTP	**5oxo-MEHTP**	**5cx-MEPTP**	**2cx-MMHTP**	**Σ all four**
0–24 h (%)	1.72 (1.22–2.28)	0.95 (0.54–1.55)	12.24 (6.34–19.72)	0.27 (0.16–0.41)	15.18 (8.26–23.96)
24–48 h (%)	0.10 (0.08–0.12)	0.06 (0.03–0.07)	0.71 (0.62–0.87)	0.01 (0.01–0.02)	0.88 (0.74–1.08)
Total (%)	1.82 (1.34–2.36)	1.01 (0.57–1.63)	12.95 (6.96–20.37)	0.28 (0.17–0.42)	16.06 (9.04–24.77)

Table S5 The mean values and ranges of urinary excretion factors, as percentages of the dose on a molar basis, for Hexamoll® DINCH metabolites are provided. Data is from ref [123].

Time	CHDA	MINCH	OH-MINCH	cx-MINCH	oxo-MINCH	Oxidized metabolites	Over all Σ
0–24 h	22.24 (18.83–25.57)	0.65 (0.26–1.19)	9.55 (6.64–11.42)	1.67 (1.38–2.00)	1.85 (1.39–2.31)	13.06 (9.41–14.51)	35.96 (31.99–40.19)
24–48 h	1.46 (0.97–2.25)	0.07 (0.06–0.09)	1.18 (0.88–1.49)	0.36 (0.29–0.42)	0.18 (0.14–0.23)	1.72 (1.16–2.15)	3.25 (2.20–3.98)
0–48 h	23.70 (19.98–26.54)	0.72 (0.31–1.26)	10.73 (7.70–12.91)	2.03 (1.75–2.29)	2.03 (1.52–2.56)	14.79 (11.29–16.67)	39.21 (35.86–42.39)

Table S6. Concentrations (average± standard deviation, ng/g ww) of PFRs and plasticizers in black-spotted frog tissues. Data is from [124]

	Female Black-Spotted Frogs					**Male Black-Spotted Frogs**				
Tissue	**Liver**	**Heart**	**Kidney**	**Intestine**	**Lung**	**Liver**	**Heart**	**Kidney**	**Intestine**	**Lung**
N	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
TEP	0.18 ±0.17	0.070 ±0.030	0.16 ±0.070	0.08 ±0.040	0.14 ±0.060	0.040 ±0.010	0.020 ±0.010	0.10 ±0.010	0.030 ±0.010	0.030 ±0.020
TCEP	2.8 ±0.55	1.0 ±0.44	1.4 ±0.73	0.64 ±0.25	2.1 ±1.1	0.89 ±0.25	0.82 ±0.18	0.81 ±0.32	0.58 ±0.19	0.56 ±0.20
TCIPP	6.0 ±0.50	0.030 ±0.050	0.67 ±0.38	0.30 ±0.44	1.6 ±0.83	0.76 ±0.78	0.72 ±0.83	1.3 ±1.0	0.32 ±0.070	0.29 ±0.030
TNBP	0.68 ±0.32	0.40 ±0.33	0.56 ±0.73	0.16 ±0.11	0.28 ±0.15	0.30 ±0.12	0.070 ±0.070	0.040 ±0.070	0.020 ±0.020	0.040 ±0.030
TDCIPP	1.0 ±0.99	0.61 ±0.38	1.0 ±0.82	0.22 ±0.090	0.62 ±0.59	0.010 ±0.020	0.31 ±0.16	0.10 ±0.11	0.040 ±0.030	0.10 ±0.090
TPHP	0.62 ±0.45	0.90 ±0.75	3.4 ±3.9	0.62 ±0.54	0.84 ±0.43	0.14 ±0.13	0.23 ±0.17	0.33 ±0.060	0.27 ±0.11	0.12 ±0.12
TBOEP	0.29 ±0.41	0.050 ±0.080	2.8 ±1.7	1.2 ±2.0	0.42 ±0.66	ND	0.020 ±0.030	1.5 ±1.2	0.20 ±0.15	0.050 ±0.050
EHDPHP	0.99 ±1.0	0.35 ±0.39	0.22 ±0.12	0.13 ±0.11	0.060 ±0.10	0.14 ±0.13	0.090 ±0.070	0.36 ±0.24	0.14 ±0.060	0.12 ±0.11
TpTP	0.050 ±0.010	0.28 ±0.29	0.18 ±0.10	0.060 ±0.060	0.090 ±0.070	0.020 ±0.020	0.060 ±0.060	0.070 ±0.030	0.030 ±0.010	0.020 ±0.010
TEHP	0.15 ±0.070	0.33 ±0.31	0.080 ±0.070	0.070 ±0.060	0.060 ±0.060	0.070 ±0.080	0.080 ±0.040	0.19 ±0.040	0.10 ±0.010	0.060 ±0.050
iDDPHP	0.14 ±0.040	0.31 ±0.25	0.46 ±0.13	0.18 ±0.18	0.22 ±0.11	0.050 ±0.070	0.070 ±0.030	0.12 ±0.050	0.040 ±0.020	0.050 ±0.050
RDP	ND	0.010 ±0.010	0.020 ±0.020	0.010 ±0.010	ND	ND	ND	ND	ND	0.010 ±0.010
BDP	0.15 ±0.040	0.18 ±0.20	0.44 ±0.36	0.12 ±0.10	0.070 ±0.060	0.040 ±0.060	0.010 ±0.010	0.040 ±0.020	0.090 ±0.15	0.010 ±0.010
∑PFRs	13 ±4.6	4.50 ±3.5	11 ±9.1	3.8 ±4.0	6.5 ±4.2	2.5 ±1.7	2.5 ±1.7	5.0 ±3.1	1.9 ±0.82	1.4 ±0.78
DMP	2.3 ±2.5	20 ±33	83 ±91	25 ±19	16 ±24	52 ±30	33 ±18	61± 20	105 ±82	55 ±29
DEP	5.7 ±3.0	57 ±82	90 ±156	39 ±21	6.8 ±8.3	60 ±55	31 ±11	14 ±13	77 ±44	52 ±45

DiBP	44 ± 33	49 ± 29	354 ± 472	182 ± 77	238 ± 213	278 ± 180	139 ± 51	202 ± 59	196 ± 47	164 ± 73
DnBP	2066 ± 1816	858 ± 1190	691 ± 378	481 ± 226	842 ± 79	514 ± 165	477± 88	717 ± 125	626 ± 137	499 ± 181
BBzP	1.2 ± 0.77	29 ± 49	0.62 ± 1.1	2.5 ± 4.4	1.1 ± 1.5	2.2 ± 3.9	3.9 ± 3.5	1.3 ± 1.6	0.15 ± 0.26	0.74 ± 1.3
DEHP	3081 ± 220	1443 ± 1311	1773 ± 1186	884 ± 724	1142 ± 400	551 ± 362	160 ± 11	503 ± 229	515 ± 366	251 ± 100
DEHT	45 ± 24	10 ± 8.0	36 ± 49	14 ± 6.0	26 ± 17	4.6 ± 4.2	12 ± 12	12 ± 9.5	24 ± 13	26 ± 28
DIDP	16 ± 2.5	28 ± 24	64 ± 20	84 ± 48	88 ± 104	4.8 ± 7.0	ND	ND	40 ± 17	30 ± 22
DINCH	229 ± 190	86 ± 112	ND	58 ± 42	82 ± 117	7.2 ± 7.7	ND	45 ± 79	81 ± 61	40 ± 38
∑Plasticizers	5503 ± 2181	2584 ± 1601	3103 ± 444	1772 ± 846	2448 ± 822	1478 ± 739	858 ± 116	1561 ± 38	1666 ± 701	1120 ± 317

Table S7. Concentrations (average ± standard deviation, ng/g ww) of PFRs and plasticizers in bullfrog tissues. Data is from [124]

Tissues	Female Bullfrogs					Male Bullfrogs				
	Liver	**Heart**	**Kidney**	**Intestine**	**Lung**	**Liver**	**Heart**	**Kidney**	**Intestine**	**Lung**
N	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**
TEP	1.9 ± 1.8	0.070 ± 0.10	0.55 ± 0.67	0.30 ± 0.23	0.060 ± 0.050	0.70 ± 0.45	0.14 ± 0.20	0.53 ± 0.40	0.18 ± 0.15	0.040 ± 0.050
TCEP	19 ± 16	4.0 ± 2.1	6.7 ± 7.2	1.6 ± 1.7	1.5 ± 1.1	9.5 ± 6.6	5.3 ± 2.3	4.1 ± 5.1	1.8 ± 1.7	1.1 ± 1.0
TCIPP	0.62 ± 0.22	0.77 ± 0.40	0.25 ± 0.21	0.16 ± 0.15	0.16 ± 0.23	0.48 ± 0.17	0.83 ± 0.25	0.25 ± 0.28	ND	0.030 ± 0.060
TNBP	0.56 ± 0.20	0.11 ± 0.050	0.10 ± 0.030	0.070 ± 0.030	ND	0.31 ± 0.21	0.090 ± 0.030	0.10 ± 0.060	0.010 ± 0.030	ND
TDCIPP	0.59 ± 0.33	ND	0.030 ± 0.030	0.070 ± 0.040	0.050 ± 0.070	0.26 ± 0.20	ND	0.080 ± 0.070	0.050 ± 0.060	0.020 ± 0.030
TPHP	17 ± 25	0.010 ± 0.020	1.3 ± 1.2	1.2 ± 1.1	0.56 ± 0.39	1.9 ± 1.4	0.11 ± 0.12	0.79 ± 0.35	0.49 ± 0.42	0.47 ± 0.30
TBOEP	2.0 ± 1.6	ND	2.1 ± 1.7	0.75 ± 0.49	0.49 ± 0.49	0.52 ± 0.46	0.030 ± 0.040	1.8 ± 2.2	1.7 ± 3.0	0.89 ± 1.6
EHDPHP	0.49 ± 0.55	0.020 ± 0.030	0.86 ± 0.72	0.69 ± 0.33	0.23 ± 0.31	0.29 ± 0.35	0.010 ± 0.030	1.9 ± 1.9	0.27 ± 0.23	0.17 ± 0.24
TpTP	1.1 ± 0.43	0.56 ± 0.22	0.57 ± 0.65	0.090 ± 0.030	0.26 ± 0.21	0.84 ± 0.60	0.63 ± 0.15	0.080 ± 0.10	0.11 ± 0.070	0.22 ± 0.28
TEHP	0.54 ± 0.45	0.050 ± 0.040	0.16 ± 0.080	0.17 ± 0.040	0.16 ± 0.11	0.23 ± 0.17	0.050 ± 0.060	0.26 ± 0.21	0.18 ± 0.16	0.33 ± 0.23
iDDPHP	0.26 ± 0.45	ND	0.040 ± 0.050	0.10 ± 0.090	0.080 ± 0.12	0.080 ± 0.080	ND	0.080 ± 0.080	0.020 ± 0.030	0.040 ± 0.040
RDP	0.49 ± 0.46	ND	0.070 ± 0.060	0.13 ± 0.080	0.030 ± 0.040	0.17 ± 0.16	ND	0.18 ± 0.25	0.020 ± 0.040	0.12 ± 0.24
BDP	0.76 ± 0.77	0.32 ± 0.70	0.13 ± 0.070	2.3 ± 4.5	0.060 ± 0.060	0.19 ± 0.19	ND	0.37 ± 0.66	0.050 ± 0.060	0.18 ± 0.23
∑PFRs	46 ± 29	5.9 ± 2.5	13 ± 6.8	7.6 ± 4.1	3.6 ± 1.2	16 ± 4.4	7.2 ± 2.2	10 ± 3.7	4.9 ± 2.8	3.6 ± 1.3
DMP	23 ± 12	5.5 ± 4.5	45 ± 34	9.7 ± 4.5	14 ± 12	39 ± 45	5.5 ± 5.5	32 ± 24	7.55 ± 6.2	13 ± 9.6
DEP	29 ± 28	4.9 ± 4.7	36 ± 28	9.1 ± 3.8	13 ± 11	48.33 ± 57.39	3.1 ± 3.2	29 ± 26	5.36 ± 3.6	12 ± 7.8
DiBP	252 ± 132	77 ± 33	731 ± 624	120 ± 54	34 ± 28	435 ± 748	53 ± 53	485 ± 560	97 ± 73	29 ± 25
DnBP	1146 ± 751	514 ± 223	609 ± 161	861 ± 459	174 ± 148	766 ± 821	430 ± 264	412 ± 297	412 ± 339	155 ± 117
BBzP	8.0 ± 8.9	0.42 ± 0.57	0.51 ± 0.74	1.1 ± 1.0	0.11 ± 0.14	0.85 ± 0.84	0.18 ± 0.34	0.37 ± 0.59	0.13 ± 0.14	0.060 ± 0.020
DEHP	1542 ± 1430	74 ± 96	286 ± 102	321 ± 225	96 ± 101	969 ± 859	146 ± 165	707 ± 352	378 ± 415	217 ± 128
DEHT	64 ± 48	72 ± 158	18 ± 8.3	25 ± 20	9.6 ± 8.0	30 ± 32	20 ± 23	29 ± 22	20 ± 16	13 ± 18
DIDP	128 ± 109	4.3 ± 5.9	56 ± 45	65 ± 28	9.8 ± 5.9	49 ± 48	11 ± 18	53 ± 40	31 ± 26	7.9 ± 5.8
DINCH	312 ± 376	0.54 ± 1.2	5.2 ± 5.6	11 ± 18	3.0 ± 2.4	6.3 ± 7.6	3.2 ± 2.9	10 ± 8.3	11 ± 7.4	18 ± 34
∑Plasticizers	3504 ± 1067	753 ± 487	1787 ± 645	1423 ± 712	355 ± 184	2344 ± 1399	672 ± 487	1758 ± 992	961 ± 819	465 ± 148

Table S8. Biological parameters and PFR, PFR metabolites and plasticizer concentrations (ng/g ww, mean ± standard deviation) for the analyzed organisms. Data is from [125]

Species	**Detection frequency (%)**	**Water snake**	**Snake egg**	**Common carp**
		(n= 7)	(n= 3)	(n= 6)
Length (cm)		44–65	0.5–0.8	3–5
Weight (g)		30–224	27–38	0.5–1
Lipid (%, ww)		0.75 ± 0.22	14 ± 2.3	1.2 ± 0.22
Organophosphorus flame retardants				
TEP	93	0.24 ± 0.21	1.0 ± 0.57	0.96 ± 0.40
TCEP	93	0.046 ± 0.032	0.16 ± 0.045	0.21 ± 0.10
TCIPP	100	0.31 ± 0.17	0.96 ± 0.18	3.1 ± 0.48
TNBP	100	0.79 ± 0.81	7.7 ± 1.4	3.0 ± 1.4
TDCIPP	47	0.32 ± 0.78	0.29 ± 0.51	0.24 ± 0.21
TPHP	100	0.23 ± 0.11	1.6 ± 1.7	6.2 ± 1.8
EHDPHP	47	ND	0.61 ± 0.80	0.24 ± 0.32
TPTP	53	ND	0.011 ± 0.0070	0.21 ± 0.087
TEHP	100	0.014 ± 0.011	0.11 ± 0.088	0.13 ± 0.045
$\sum_9$ PFRs		1.9 ± 1.2	12 ± 2.3	14 ± 2.4
iDDPHP	47	0.049 ± 0.13	0.82 ± 1.0	0.30 ± 0.36
RDP	60	ND	0.075 ± 0.088	0.45 ± 0.36
BDP	93	0.16 ± 0.094	0.26 ± 0.32	1.3 ± 1.1
$\sum_3$ ePFRs		0.22 ± 0.13	1.2 ± 0.93	2.0 ± 1.2
Plasticizers				
DMP	87	0.23 ± 0.18	1.6 ± 0.55	0.25 ± 0.26
DEP	53	2.2 ± 3.3	20 ± 14	2.7 ± 4.2
DnBP	93	4.3 ± 3.2	15 ± 13	42 ± 53
DiBP	87	14 ± 18	35 ± 13	56 ± 74
DPP	100	0.19 ± 0.20	0.61 ± 0.36	0.24 ± 0.13
BBzP	73	0.54 ± 0.59	4.2 ± 1.3	0.12 ± 0.11
DEHP	100	111 ± 80	1191 ± 327	250 ± 188
$\sum_7$ LPs		132 ± 76	1268 ± 349	351 ± 169
Alternative Plasticizers				
ATEC	87	ND	0.12 ± 0.047	0.32 ± 0.65
DIBA	80	0.066 ± 0.11	0.61 ± 0.41	1.4 ± 1.4
CDPHP	100	0.50 ± 0.23	3.1 ± 1.5	4.1 ± 1.2
ATBC	20	0.37 ± 0.97	ND	13 ± 19

DBS	13	0.68 ± 1.8	5.6 ± 9.8	ND
DEHA	93	3.4 ± 2.9	9.2 ± 4.9	3.6 ± 1.9
BTHC	33	ND	0.48 ± 0.20	0.55 ± 0.77
THTM	53	0.026 ± 0.064	1.9 ± 1.2	0.42 ± 0.56
TOTM	93	3.6 ± 4.1	1.4 ± 1.8	9.6 ± 3.1
DEHT	87	3.2 ± 2.7	3.4 ± 5.5	12 ± 10
DINP	80	3.8 ± 3.0	15 ± 26	5.8 ± 7.0
DINCH	73	0.27 ± 0.29	0.76 ± 1.3	2.8 ± 3.2
DIDP	100	1.1 ± 0.77	9.6 ± 9.7	3.8 ± 2.0
$\sum_{13}$ APs		19 ± 7.5	52 ± 62	59 ± 28
PFR metabolites BCIPP	69	0.17 ± 0.13	0.073 ± 0.13	0.54 ± 0.11
DNBP	92	0.47 ± 0.30	0.39 ± 0.29	0.51 ± 0.32
DPHP	100	0.39 ± 0.37	0.50 ± 0.15	0.61 ± 0.37
BBOEP	61	0.076 ± 0.12	0.29 ± 0.37	0.41 ± 0.24
BCIPHIPP	100	0.029 ± 0.013	0.037 ± 0.013	0.19 ± 0.16
EHPHP	100	0.11 ± 0.033	0.32 ± 0.10	0.24 ± 0.24
BBOEHEP	85	ND	0.022 ± 0.038	0.019 ± 0.010
HO-TBOEP	100	ND	0.031 ± 0.033	0.019 ± 0.0090
HO-TPHP	92	0.061 ± 0.057	0.28 ± 0.22	1.3 ± 1.9
5-HO-EHDPHP	31	ND	0.046 ± 0.080	0.059 ± 0.045
∑Total metabolites		1.3 ± 0.49	2.0 ± 0.41	2.8 ± 0.41

Table S9. Ranges, mean, and standard deviations of OPE concentrations (ng/g dw) detected in fish tissues collected from Laizhou Bay, China. Data is from [126]

Compound	Muscle	Liver	Kidney	Gill
TMP	nd-2.8 (0.9 ± 0.9)	nd-6.0 (2.6 ± 1.5)	nd-7.4 (2.5 ± 1.7)	nd-3.3 (1.6 ± 0.9)
TEP	nd-4.8 (1.9 ± 1.3)	nd-6.1 (3.4 ± 1.5)	nd-10.0 (3.5 ± 2.3)	nd-4.6 (2.6 ± 1.0)
TPrP	nd-2.2 (0.6 ± 0.5)	nd-4.2 (1.7 ± 1.2)	nd-3.1 (1.5 ± 0.8)	nd-3.2 (0.8 ± 0.7)
TiBP	nd-2.9 (0.8 ± 0.7)	nd-5.2 (1.7 ± 1.3)	nd-2.8 (1.4 ± 0.8)	nd-2.9 (0.9 ± 0.8)
TBP	nd-13.1 (4.8 ± 2.9)	nd-12.9 (5.4 ± 3.1)	nd-14.6 (6.2 ± 3.8)	nd-7.6 (4.6 ± 1.7)
TCEP	nd-5.8 (1.8 ± 1.7)	nd-8.6 (3.1 ± 2.6)	nd-10.0 (2.9 ± 2.4)	nd-3.3 (1.7 ± 0.9)
TCPP	nd-6.1 (1.9 ± 1.8)	nd-9.0 (3.4 ± 3.0)	nd-14.0 (3.6 ± 3.5)	nd-4.0 (2.1 ± 1.2)
TPeP	nd-1.9 (0.6 ± 0.6)	nd-6.6 (1.7 ± 1.5)	nd-9.3 (2.2 ± 2.4)	nd-2.7 (0.9 ± 0.6)
THP	nd-6.2 (1.2 ± 1.5)	nd-9.0 (2.6 ± 2.5)	nd-7.1 (2.7 ± 1.9)	nd-4.1 (1.2 ± 1.0)
TDCIPP	nd-2.5 (0.4 ± 0.5)	nd-6.8 (1.8 ± 1.7)	nd-4.2 (1.6 ± 1.3)	nd-2.2 (0.8 ± 0.6)
TBOEP	nd-10.1 (2.3 ± 2.9)	nd-24.7 (4.6 ± 6.0)	nd-17.0 (4.5 ± 4.9)	nd-9.0 (2.9 ± 2.5)
TPhP	nd-8.4 (1.6 ± 2.3)	nd-17.3 (4.0 ± 4.2)	nd-14.7 (4.1 ± 4.1)	nd-6.0 (2.7 ± 2.0)
EHDP	nd-7.7 (2.7 ± 2.4)	nd-15.2 (4.6 ± 3.7)	nd-11.4 (4.2 ± 3.6)	nd-8.7 (2.9 ± 2.1)
TEHP	nd-12.3 (2.6 ± 3.3)	nd-18.4 (4.9 ± 4.6)	nd-16.5 (5.2 ± 5.1)	nd-7.3 (2.1 ± 1.7)
CDPP	nd-6.0 (1.2 ± 1.6)	nd-9.3 (2.6 ± 2.0)	nd-6.6 (3.1 ± 2.1)	nd-3.3 (1.4 ± 0.8)
TPPO	nd-1.5 (0.5 ± 0.5)	nd-7.2 (1.9 ± 1.6)	nd-4.7 (1.9 ± 1.1)	nd-1.1 (0.7 ± 0.3)
TCP	nd-6.0 (1.1 ± 1.4)	nd-9.3 (3.5 ± 2.5)	nd-6.7 (3.1 ± 1.8)	nd-4.2 (1.7 ± 1.1)

Table S10. Ranges, mean, and standard deviations of OPE concentrations (ng/g lw) detected in fish tissues collected from Laizhou Bay, China. Data is from [126]

Compound [a]	Muscle	Liver	Kidney	Gill
TMP	nd[b] -147.1 (46.7 ± 39.9) [c]	nd-333.7 (183.4 ± 84.8)	nd-449.5 (192.5 ± 95.6)	nd-212.0 (109.9 ± 58.1)
TEP	nd-203.3 (110.3 ± 45.0)	nd-448.0 (246.2 ± 97.6)	nd-603.3 (278.6 ± 130.1)	nd-277.7 (177.4 ± 59.8)
TPrP	nd-90.0 (34.2 ± 18.3)	nd-292.4 (118.3 ± 63.8)	nd-205.1 (120.5 ± 51.8)	nd-194.6 (55.1 ± 42.7)
TiBP	nd-133.2 (44.3 ± 24.2)	nd-189.7 (111.6 ± 40.2)	nd-198.0 (114.4 ± 51.9)	nd-178.4 (58.9 ± 44.0)
TBP	nd-540.1 (295.9 ± 158.8)	nd-706.9 (385.5 ± 159.3)	nd-885.1 (484.7 ± 230.2)	nd-505.4 (317.7 ± 115.1)
TCEP	nd-478.7 (114.7 ± 125.4)	nd-734.0 (229.0 ± 199.2)	nd-604.3 (225.8 ± 154.1)	nd-351.7 (133.9 ± 97.3)
TCPP	nd-369.2 (116.9 ± 116.2)	nd-739.5 (240.0 ± 206.0)	nd-846.5 (280.6 ± 216.4)	nd-334.7 (159.6 ± 105.3)
TPeP	nd-110.1(35.4 ± 34.2)	nd-198.8 (114.5 ± 53.0)	nd-560.5 (175.9 ± 145.2)	nd-150.9 (59.6 ± 34.9)
THP	nd-268.5 (62.3 ± 58.1)	nd-497.9 (172.4 ± 116.4)	nd-430.9 (210.7 ± 117.8)	nd-230.3 (77.4 ± 55.5)
TDCIPP	nd-221.7 (31.2 ± 51.5)	nd-587.5 (135.1 ± 145.3)	nd-298.7 (119.6 ± 82.9)	nd-230.9 (58.0 ± 54.7)
TBOEP	nd-571.4 (145.6 ± 187.2)	nd-742.8 (300.6 ± 232.4)	nd-1026.2 (350.8 ± 309.2)	nd-507.6 (196.8 ± 146.5)
TPhP	nd-511.2 (96.6 ± 141.3)	nd-544.6 (266.1 ± 181.2)	nd-888.9 (324.9 ± 287.5)	nd-363.5 (174.6 ± 117.0)
EHDP	nd-426.5 (151.1 ± 120.4)	nd-554.0 (298.2 ± 144.1)	nd-689.9 (312.4 ± 205.3)	nd-491.1 (186.2 ± 117.1)
TEHP	nd-504.2 (134.6 ± 149.7)	nd-715.0 (324.9 ± 199.6)	nd-999.7 (391.7 ± 303.0)	nd-411.8 (140.0 ± 98.1)
CDPP	nd-346.5 (69.4 ± 86.5)	nd-281.4 (180.7 ± 67.1)	nd-474.9 (248.1 ± 142.7)	nd-268.0 (99.7 ± 64.8)
TPPO	nd-106.4 (31.2 ± 33.3)	nd-257.6 (124.9 ± 56.8)	nd-284.2 (156.2 ± 68.6)	nd-112.3 (48.7 ± 24.7)
TCP	nd-216.3 (59.4 ± 60.0)	nd-487.7 (241.2 ± 97.3)	nd-448.9 (250.5 ± 131.5)	nd-255.3 (114.4 ± 66.1)

nd= not detected

Table S11. Tissue concentration (ng/g dw) of ΣOPEs, ΣNon-Cl alkyl OPEs, ΣCl alkyl OPEs, and ΣAryl-OPEs in 5 benthic fish and 5 pelagic fish species collected from Laizhou Bay. Data is from [126].

Tissue	Pelagic fish					Benthic Fish				
	Chinese sea perch	Dotted gizzard shad	Halfbeak	Mullet	Silvery pomfret	Eelgoby	Fat greenling	Flathead	Javeline goby	Tongue sole
ΣNon-Cl alkyl OPEs										
Muscle	22.4 ± 2.1	11.8 ± 1.3	3.8 ± 0.5	9.6 ± 1.2	29.3 ± 6.2	9.5 ± 3.1	19.6 ± 4.0	28.4 ± 3.3	13.6 ± 3.2	12.9 ± 1.9
Liver	25.7 ± 3.1	19.2 ± 2.6	7.9 ± 0.9	19.1 ± 2.6	39.9 ± 3.5	22.6 ± 3.7	29.6 ± 5.3	59.2 ± 10.2	48.8 ± 4.8	21.9 ± 3.4
Kidney	19.4 ± 2.0	15.8 ± 1.9	10.5 ± 1.6	15.9 ± 2.3	31.9 ± 3.0	17.0 ± 2.6	35.2 ± 4.1	64.6 ± 9.8	22.6 ± 2.7	26.7 ± 3.7
Gills	20.4 ± 2.0	10.0 ± 2.0	9.1 ± 1.2	11.6 ± 2.2	25.3 ± 2.2	15.0 ± 2.9	15.4 ± 2.7	36.3 ± 6.3	17.4 ± 3.6	12.8 ± 3.1
p value	0.805	0.255	0.121	0.245	0.218	0.249	0.281	0.146	< 0.001	0.175
ΣCl alkyl OPEs										
Muscle	1.1 ± 0.2	4.8 ± 4.3	0.7 ± 0.3	2.4 ± 0.3	1.2 ± 0.1	13.3 ± 2.6	8.2 ± 3.2	2.4 ± 0.4	2.8 ± 4.3	5.7 ± 1.2
Liver	2.7 ± 0.1	8.8 ± 2.8	1.7 ± 0.4	7.6 ± 2.5	3.5 ± 0.6	20.7 ± 2.2	13.9 ± 6.3	7.5 ± 2.7	15.9 ± 3.9	7.4 ± 1.8
Kidney	2.7 ± 0.4	5.6 ± 1.9	2.7 ± 1.1	5.9 ± 2.1	2.8 ± 0.7	14.7 ± 1.8	17.0 ± 4.5	9.6 ± 2.1	8.6 ± 3.6	8.9 ± 2.4
Gills	2.3 ± 0.1	4.4 ± 2.6	2.0 ± 0.9	3.5 ± 1.0	4.1 ± 1.1	8.7 ± 1.2	7.3 ± 3.4	5.3 ± 2.5	5.5 ± 2.2	6.6 ± 2.4
p value	< 0.001	0.593	0.244	0.176	0.007	0.044	0.440	0.114	0.032	0.717
ΣAryl-OPEs										
Muscle	7.8 ± 1.7	1.7 ± 1.2	2.1 ± 0.8	5.2 ± 0.6	13.9 ± 4.4	2.6 ± 0.9	8.4 ± 2.6	15.2 ± 4.0	12.8 ± 5.8	4.7 ± 1.0
Liver	15.2 ± 3.2	8.5 ± 0.4	4.3 ± 0.7	12.7 ± 1.5	18.3 ± 5.6	17.3 ± 2.4	15.0 ± 4.0	39.1 ± 5.7	35.5 ± 4.9	10.0 ± 1.3
Kidney	13.9 ± 2.0	5.7 ± 0.1	5.1 ± 0.4	9.8 ± 1.3	15.2 ± 3.9	12.3 ± 2.0	21.7 ± 2.3	32.9 ± 4.8	18.2 ± 3.6	13.8 ± 2.1
Gills	12.3 ± 1.1	2.5 ± 0.3	4.3 ± 0.5	6.2 ± 1.6	10.5 ± 2.1	9.1 ± 1.1	7.4 ± 2.1	21.9 ± 5.8	11.7 ± 2.9	4.5 ± 0.8
p value	0.368	<0.001	0.013	0.013	0.760	0.003	0.076	0.080	0.003	0.001

Table S12. Mean concentration of OPEs (Cs) measured in seawater, and ranges of Log BAFs in different fish tissues from Laizhou Bay, China. Data is from [126].

Compound	Cs (ng/L)	log *BAF* (L/kg wet weight)			
		Muscle	Liver	Kidney	Gill
TMP	6.0	1.1-3.2 (2.4 ± 0.6)[C]	2.7-3.5 (3.2 ± 0.2)	2.9-3.5 (3.2 ± 0.2)	2.2-3.2 (2.7 ± 0.3)
TEP	3.9	2.8-3.6 (3.2 ± 0.2)	3.1-3.7 (3.6 ± 0.2)	3.4-3.8 (3.6 ± 0.2)	2.9-3.5 (3.2 ± 0.2)
TPrP	1.8	2.7-3.5 (3.0 ± 0.3)	3.0-4.0 (3.5 ± 0.2)	3.3-3.9 (3.5 ± 0.2)	2.3-3.2 (3.0 ± 0.3)
TIBP	3.5	2.2-3.3 (2.8 ± 0.3)	2.8-3.7 (3.3 ±0.2)	2.8-3.5 (3.2 ± 0.2)	2.7-3.8 (3.2 ± 0.3)
TBP	15.2	2.5-3.3 (3.0 ± 0.2)	2.7-3.4 (3.1 ± 0.2)	2.9-3.4 (3.2 ± 0.2)	2.6-3.8 (3.0 ± 0.3)
TCEP	5.5	2.1-3.6 (2.9 ± 0.5)	2.6-3.8 (3.3 ± 0.4)	2.8-3.7 (3.3 ± 0.3)	2.9-4.0 (3.3 ± 0.3)
TCPP	18.8	1.8-3.1 (2.4 ± 0.4)	2.2-3.3 (2.8 ± 0.4)	2.5-3.2 (2.8 ± 0.3)	2.0-3.4 (2.7 ± 0.4)
TPeP	1.3	1.9-3.7 (3.0 ± 0.7)	3.3-4.0 (3.7 ± 0.3)	3.3-3.3 (3.7 ± 0.3)	3.2-4.3 (3.6 ± 0.4)
THP	1.2	2.7-4.1 (3.2 ± 0.4)	3.3-4.4 (3.8 ± 0.3)	3.4-4.3 (3.8 ± 0.3)	2.2-3.4 (2.8 ± 0.4)
TDCIPP	1.6	1.5-3.6 (2.7 ± 0.6)	3.0-4.2 (3.6 ± 0.4)	3.2-3.0 (3.5 ± 0.3)	2.5-3.3 (2.9 ± 0.3)
TBOEP	11.7	1.3-3.4 (2.6 ± 0.7)	2.2-3.6 (3.1 ± 0.5)	2.3-3.7 (3.0 ± 0.4)	2.0-2.7 (2.5 ± 0.3)
TPhP	6.0	1.1-3.7 (2.3 ± 1.1)	2.6-3.7 (3.3 ± 0.4)	2.8-3.9 (3.3 ± 0.3)	2.4-3.6 (3.1 ± 0.4)
EHDP	4.5	2.3-3.7 (3.2 ± 0.4)	2.9-3.8 (3.5 ± 0.3)	3.0-3.8 (3.5 ± 0.3)	2.4-3.4 (2.9 ± 0.4)
TEHP	1.0	3.0-4.6 (3.8 ± 0.5)	3.6-4.6 (4.2 ± 0.3)	3.9-4.7 (4.2 ± 0.3)	2.7-3.8 (3.1 ± 0.4)
CDPP	0.5	2.8-4.4 (3.8 ± 0.6)	3.9-4.7 (4.4 ± 0.2)	4.0-4.7 (4.4 ± 0.2)	3.5-4.3 (3.9 ± 0.3)
TPPO	5.2	1.5-3.0 (2.4 ± 0.4)	2.7-3.5 (3.1 ± 0.2)	3.0-3.3 (3.2 ± 0.1)	3.3-4.3 (3.8 ± 0.3)

TCP	0.6	2.8-4.2 (3.6 ± 0.5)	4.0-4.7 (4.3 ± 0.2)	4.0-4.5 (4.3 ± 0.2)	2.3-2.8 (2.5 ± 0.2)

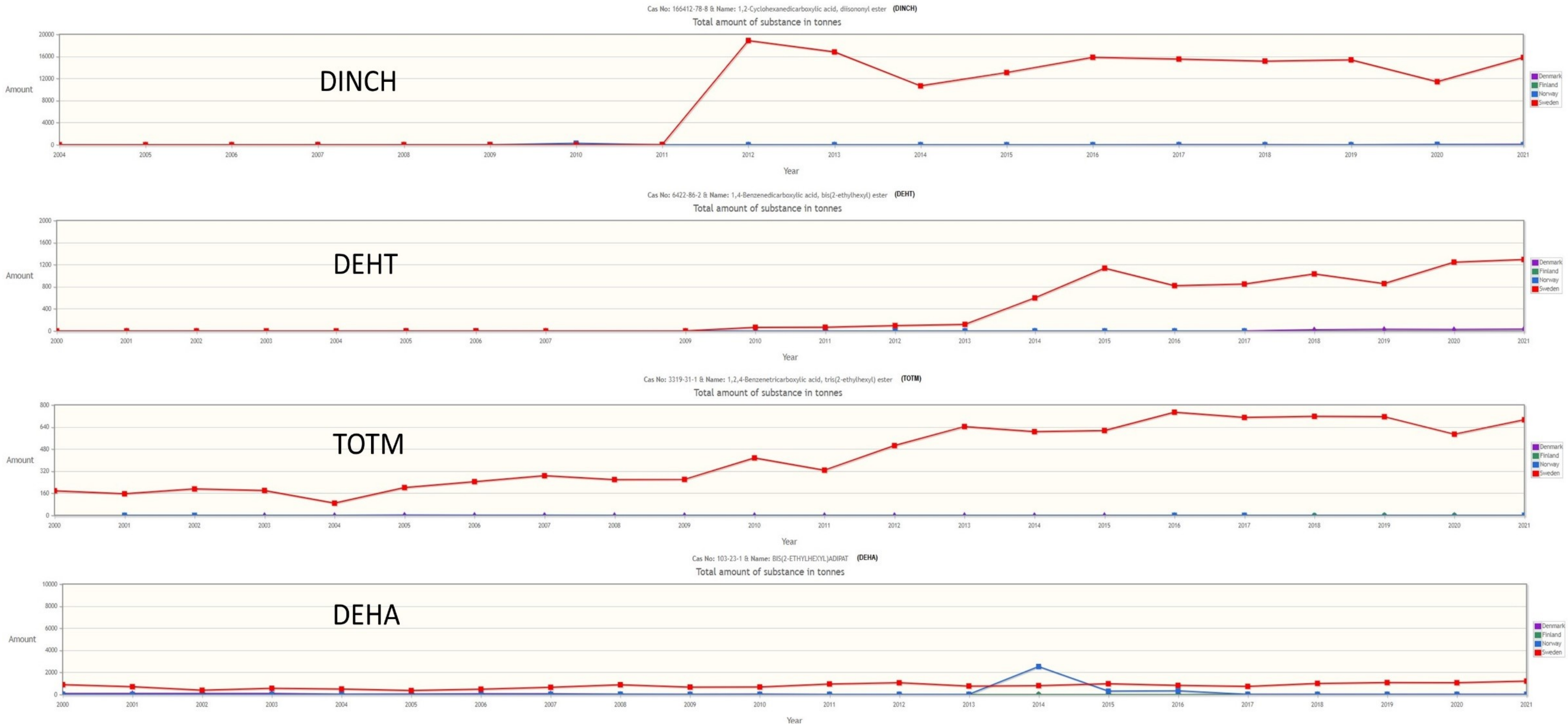


Figure S1. Image indicating that production volumes of few alternative plasticizers is increasing in Nordic Countries. For a clearer view of this image, it is advisable to open it as a whole on separate page. This is from SPIN database (http://www.spin2000.net/spinmyphp/)

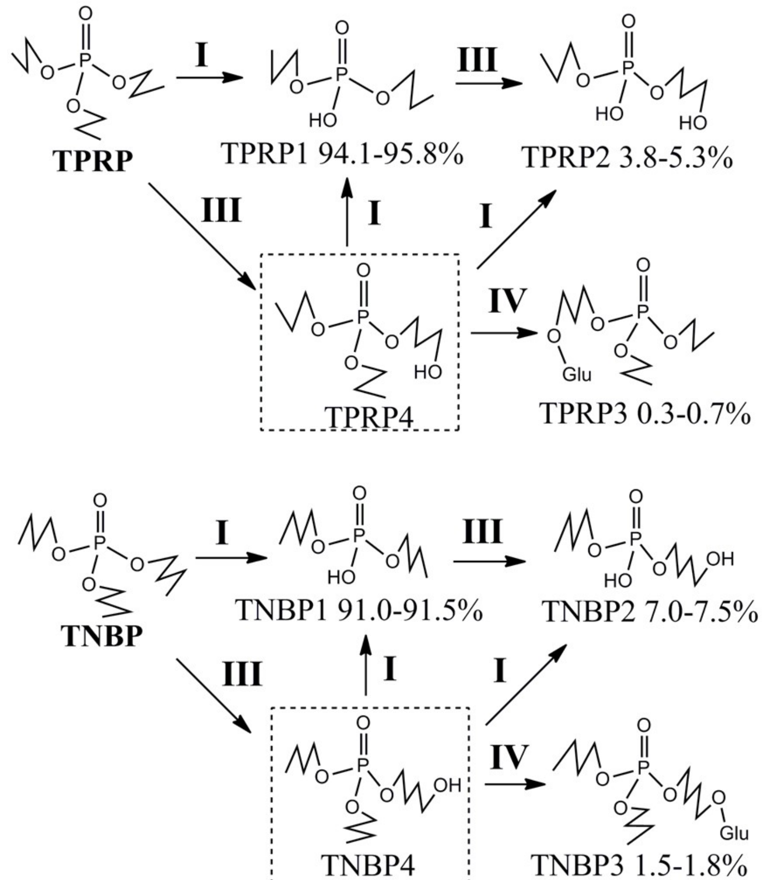


Figure S2. The proposed metabolic pathway of TPRP and TNBP, in zebrafish. I, III, IV, and V are the reaction of scission of the ester bond (or hydrolysis), oxidative hydroxylation, glucuronic acid conjugation, and dechlorination. Contribution of the metabolites was calculated based on the relative peak area of individual metabolite to the total area. Metabolites not detected in liver were framed with dotted boxes. Reprinted with permission from reference [222] Copyright 2009 Elsevier.

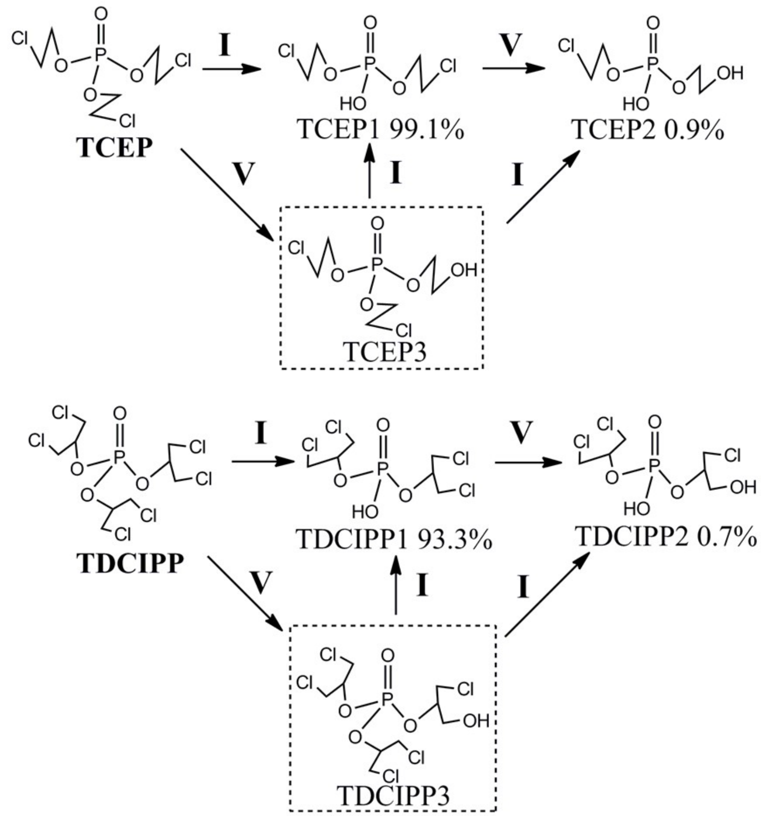


Figure S3. The proposed metabolic pathway of TCEP and TDCIPP, in zebrafish. I, III, IV, and V are the reaction of scission of the ester bond (or hydrolysis), oxidative hydroxylation, glucuronic acid conjugation, and dechlorination. Contribution of the metabolites was calculated based on the relative peak area of individual metabolite to the total area. Metabolites not detected in liver were framed with dotted boxes. Reprinted with permission from reference [222] Copyright 2009 Elsevier.

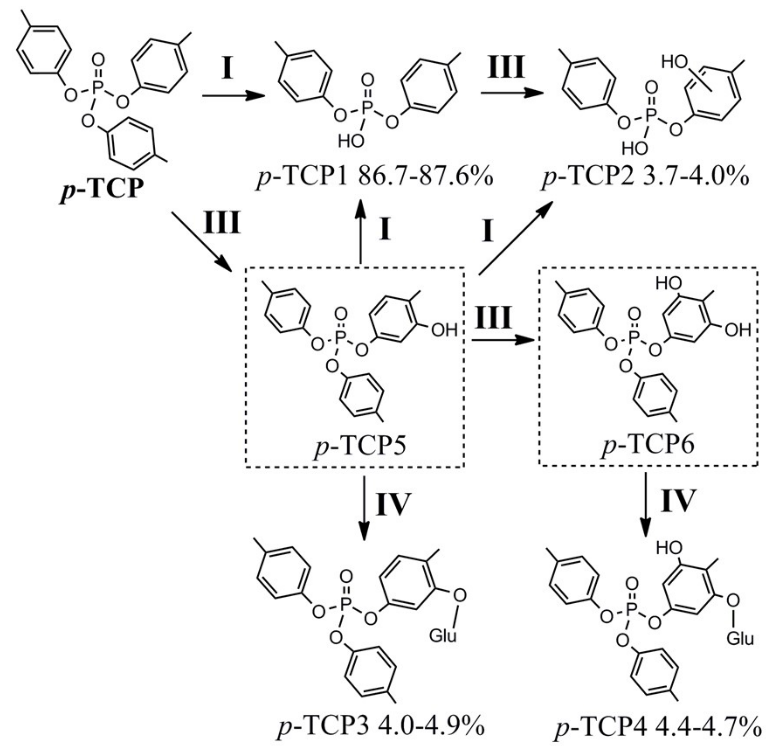


Figure S4. The proposed metabolic pathway of p-TCP, in zebrafish. I, III, IV, and V are the reaction of scission of the ester bond (or hydrolysis), oxidative hydroxylation, glucuronic acid conjugation, and dechlorination. Contribution of the metabolites was calculated based on the relative peak area of individual metabolite to the total area. Metabolites not detected in liver were framed with dotted boxes. Reprinted with permission from reference [222] Copyright 2009 Elsevier.

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