Supplementary Information for

Uptake, whole-body distribution & depuration of nanoplastics by the scallop *Pecten maximus*, at environmentally realistic concentrations

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Table of contents

Figure S1. Plot of studies targeting micro- and nanoplastics reported in the literature showing concentration (in ppb ~ µg L^{-1}) as a function of size (nm). _____ S2

Figure S2. (a) Quantitative whole-body autoradiography for nPS_{250} after 6-h uptake and (b) photography of the associated section. _____ S3

Figure S3. Photography of the section used for the QWBA in Figure 2 with (a) Pecten maximus for nPS_{24} after 6h uptake with and (b) P. maximus of nPS_{24} after 8 days of depuration. _____ S4

Figure S4. Mean ± S.D. of bioaccumulation kinetic parameters measured for ^{14}C-$nPS_{24,250}$ and $n^{110m}Ag$ from Al-Sid-Cheikh et al. [32] _____ S5

Table S1. Uptake and depuration on nPS in Bq g^{-1} and its equivalent in ng g^{-1}, ng, µg and number of particles. _____ S0

Table S2. Kinetic data for uptake and elimination of ^{14}C-labeled nPS 24 and 250 nm in the scallop Pecten maximus. _____ S1

Table S3. bioaccumulation kinetic parameters based on the data from the accumulation and depuration period (see table S1). _____ S2

Table S4. QWBA quantification of nPS_{24} after 6h of uptake and 8 days of depuration _____ S3

Equation S1. Minimum detectable activity _____ S4

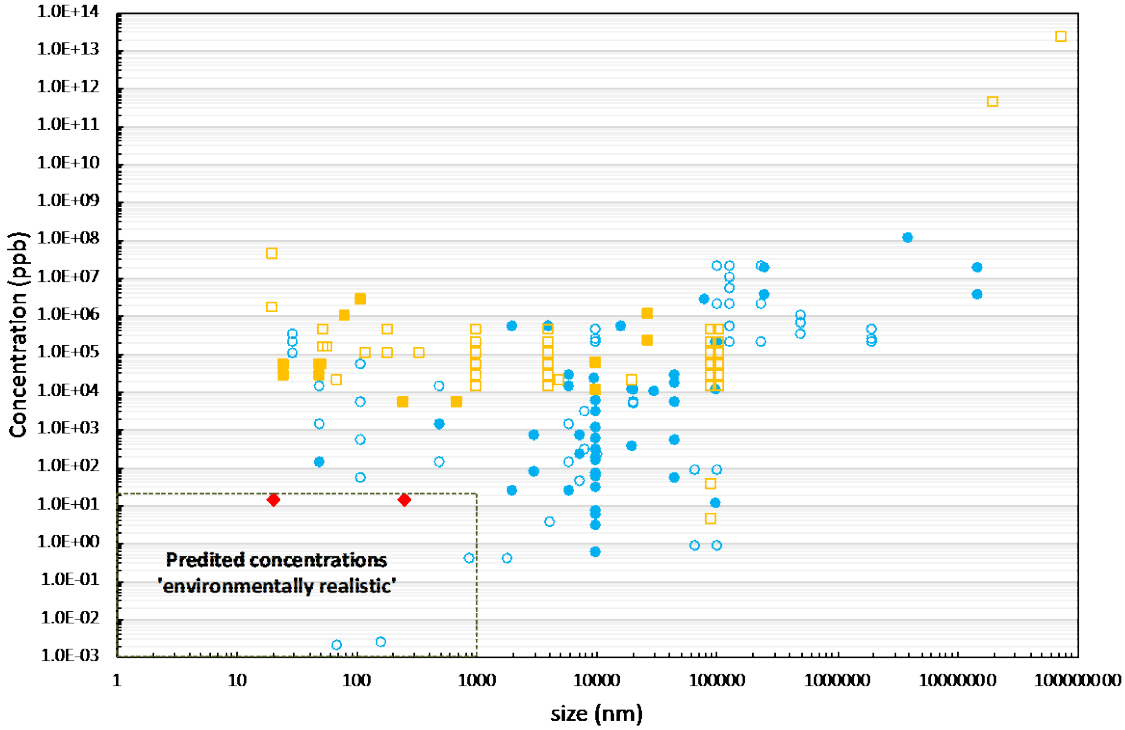

Figure S1. Plot of studies targeting micro- and nanoplastics reported in the literature showing concentration (in ppb ~ µg L^{-1}) as a function of size (nm). The green box represents the predicted 'environmental concentration' of nanoplastics as estimated by Lenz et al. [1]. Blue open circles represent experimental studies of micro- and nanoplastics on marine organisms assessing only the effects of uptake, while blue solid circles represent studies evaluating the uptake by marine organisms. Yellow open squares represent studies of micro- and nanoplastics on freshwater organisms assessing the effects of uptake, while yellow solid squares represent studies evaluating uptake itself by freshwater organisms. Red diamonds represent the present and only study quantifying uptake within the expected environmental concentration range. See references[2,3,12–21,4,22–31,5–11].

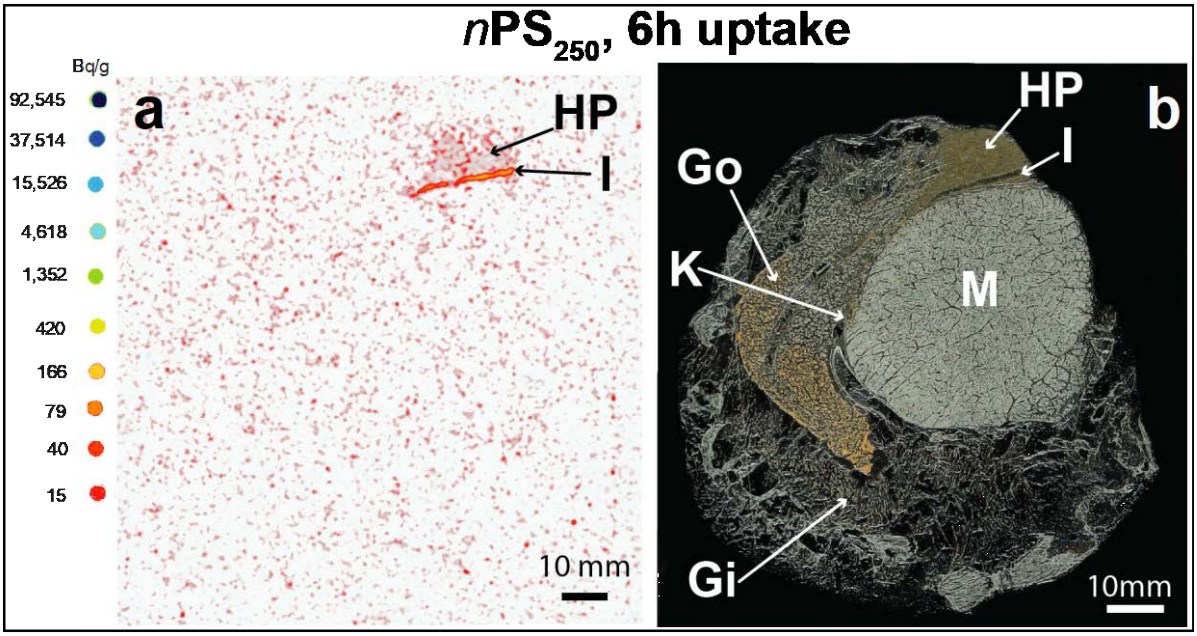

Figure S2. (a) Quantitative whole-body autoradiography for nPS_{250} after 6-h uptake and (b) photography of the associated section. HP: Hepatopancreas, I: intestine, K: Kidney, Go: Gonad, Gi: Gills, M: Muscle.

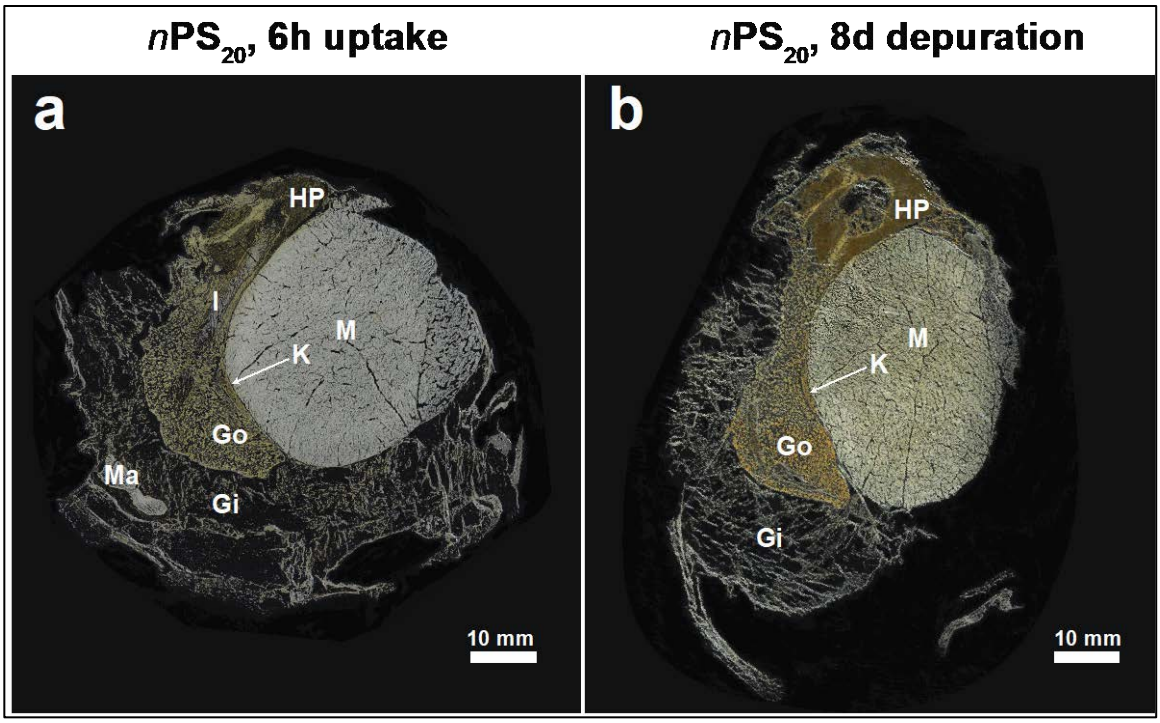

Figure S3. Photography of the section used for the QWBA in Figure 2 with (a) *Pecten maximus* for nPS_{24} after 6h uptake with and (b) P. maximus of nPS_{24} after 8 days of depuration. Abbreviations: Gi: Gills, HP Hepatopancreas, Go: Gonad, K: Kidney, M: Muscle, Ma: mantle, A: Anus.

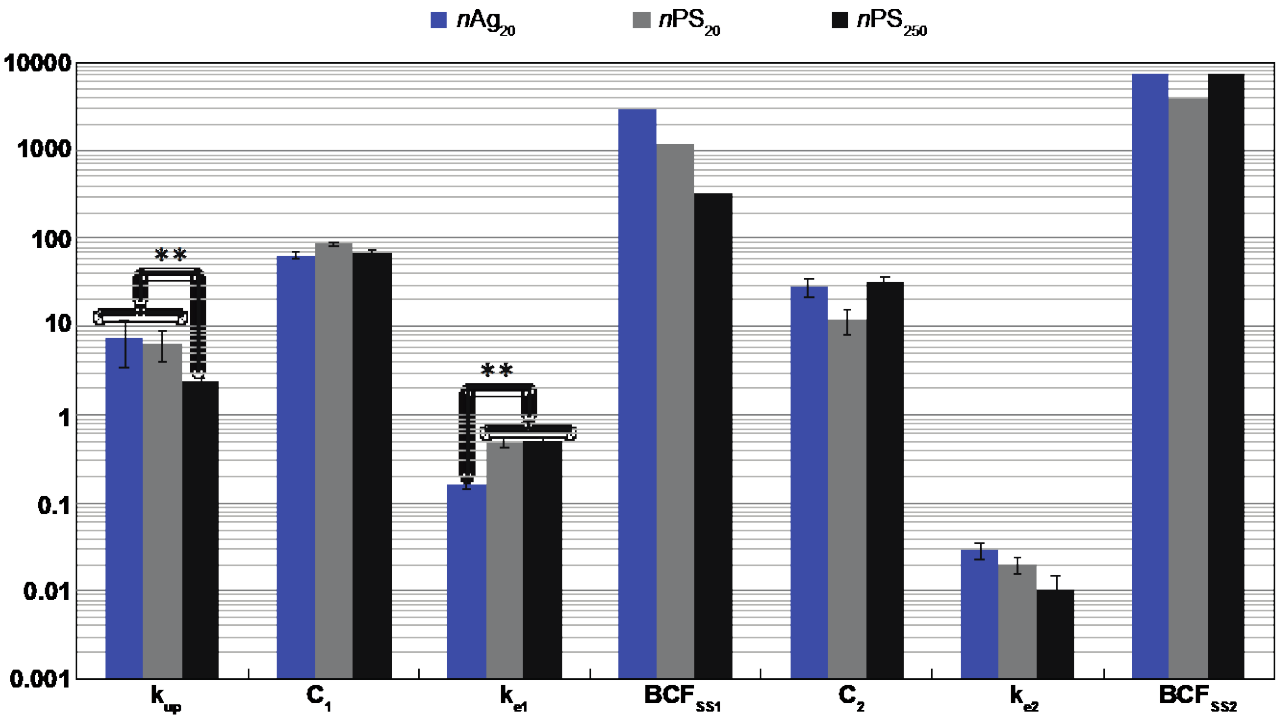

Figure S4. Mean ± S.D. of bioaccumulation kinetic parameters measured for ^{14}C-*n*PS$_{24,250}$ and n^{110m}Ag from Al-Sid-Cheikh et al. [32]. Abbreviation: K_{up}, uptake kinetic constant in mL g^{-1} d^{-1}; C_1 and C_2 is the percentage (%) in compartment 1 and 2 for the elimination, K_{e1} and K_{e2} the elimination kinetics constant (in d^{-1}) for compartment 1 and 2, $BCF_{SS\,1}$ and BCF_{SS2} are bioconcentration factor for compartment 1 and 2. See results in table S1. "**" means $p < 0.01$.

Table S1. Uptake and depuration on *n*PS in Bq g^{-1} and its equivalent in ng g^{-1}, ng, µg and number of particles.

nPS_{24}	Bq g_{ww}^{-1}	ng g_{ww}^{-1}	ng[A]	µg[A]	Number of particles[A]
Time (H)			Uptake[B]		
0	0	0	0	0	0
1	9.5 ± 4.2	28.5 ± 12.5	2081 ± 912	2.1 ± 0.9	$2.5 \times 10^{12} \pm 1.1 \times 10^{12}$
2	16.5 ± 5.4	49.6 ± 16.2	3620 ± 1180	3.6 ± 1.2	$4.3 \times 10^{12} \pm 1.4 \times 10^{12}$
3	19.1 ± 9.6	57.3 ± 28.7	4183 ± 2094	4.2 ± 2.1	$5.0 \times 10^{12} \pm 2.5 \times 10^{12}$
4.5	22.5 ± 4.5	67.5 ± 13.6	4928 ± 994	4.9 ± 1.0	$5.9 \times 10^{12} \pm 1.2 \times 10^{12}$
6	26.1 ± 7.5	78.3 ± 22.5	5716 ± 1643	5.7 ± 1.6	$6.8 \times 10^{12} \pm 1.9 \times 10^{12}$
			Uptake[C]		
0	0	0	0	0	0
2	14.0 ± 3.0	41.9 ± 8.9	3166 ± 1418	3.2 ± 1.4	$3.8 \times 10^{12} \pm 1.7 \times 10^{12}$
4.5	24.6 ± 3.3	73.9 ± 9.9	3966 ± 800	4.0 ± 0.8	$4.8 \times 10^{12} \pm 9.6 \times 10^{11}$
6	27.7 ± 7.6	83.0 ± 22.8	4857 ± 1331	4.9 ± 1.3	$5.9 \times 10^{12} \pm 1.6 \times 10^{12}$
Time (d)			Depuration[C]		
0	26.9 ± 8.3	80.6 ± 24.8	5881 ± 1812	5.8 ± 1.8	$7.0 \times 10^{12} \pm 2.2 \times 10^{12}$
1	19.5 ± 10.5	58.6 ± 32.6	4281 ± 2383	4.3 ± 2.4	$5.2 \times 10^{12} \pm 2.9 \times 10^{12}$
2	7.6 ± 2.1	22.8 ± 6.3	1666 ± 459	1.7 ± 0.4	$2.0 \times 10^{12} \pm 4.8 \times 10^{11}$
3	3.3 ± 0.9	9.8 ± 2.6	715 ± 188	0.7 ± 0.2	$8.4 \times 10^{11} \pm 2.4 \times 10^{11}$
8	2.9 ± 1.3	8.7 ± 4.0	635 ± 295	0.6 ± 0.3	$7.2 \times 10^{11} \pm 3.6 \times 10^{11}$
14	2.4 ± 0.4	7.3 ± 4.3	535 ± 316	0.5 ± 0.1	$6.0 \times 10^{11} \pm 1.2 \times 10^{11}$
24	2.6 ± 0.4	7.7 ± 1.3	561 ± 92	0.6 ± 0.1	$7.2 \times 10^{11} \pm 1.2 \times 10^{11}$
48	1.2 ± 0.3	3.6 ± 0.8	261 ± 59	0.3 ± 0.1	$3.6 \times 10^{11} \pm 1.2 \times 10^{11}$

nPS_{250}	Bq g_{ww}^{-1}	ng g_{ww}^{-1}	ng[A]	µg[A]	Number of particles[A]
Time (H)			Uptake[B]		
0	0	0	0	0	0
1	2.3 ± 0.3	7.2 ± 0.9	526 ± 66	0.5 ± 0.1	$5.3 \times 10^{8} \pm 1.1 \times 10^{8}$
2	4 ± 0.4	11.9 ± 1.2	865 ± 88	0.9 ± 0.1	$9.6 \times 10^{8} \pm 1.1 \times 10^{8}$
3	5.6 ± 2.5	16.8 ± 7.5	1226 ± 548	1.2 ± 0.5	$1.3 \times 10^{9} \pm 5.3 \times 10^{8}$
4.5	7.6 ± 4.4	22.8 ± 13.2	1664 ± 964	1.7 ± 1.0	$1.8 \times 10^{9} \pm 1.1 \times 10^{9}$
6	11.2 ± 0.7	33.6 ± 2.1	2453 ± 153	2.5 ± 0.2	$2.7 \times 10^{9} \pm 2.1 \times 10^{8}$
			Uptake[C]		
0	0	0	0	0	0
2	4.5 ± 1.4	13.4 ± 1.4	917 ± 154	0.9 ± 0.1	$9.6 \times 10^{8} \pm 1.1 \times 10^{8}$
4.5	7.9 ± 2.5	23.8 ± 2.5	1451 ± 233	1.4 ± 0.2	$1.5 \times 10^{9} \pm 2.1 \times 10^{8}$
6	10.9 ± 2.4	32.7 ± 2.4	1593 ± 139	1.6 ± 0.1	$1.7 \times 10^{9} \pm 1.1 \times 10^{8}$
Time (d)			Depuration[C]		
0	8.6 ± 4.6	25.9 ± 13.9	1893 ± 1015	1.9 ± 1.0	$2.0 \times 10^{9} \pm 1.1 \times 10^{9}$
1	9.0 ± 2.5	26.9 ± 7.6	1964 ± 558	2.0 ± 0.5	$2.1 \times 10^{9} \pm 5.3 \times 10^{8}$
2	7.1 ± 1.8	21.4 ± 5.3	1562 ± 386	1.6 ± 0.4	$1.7 \times 10^{9} \pm 4.2 \times 10^{8}$
3	3.8 ± 4.4	11.4 ± 13.3	832 ± 969	0.8 ± 1.0	$8.5 \times 10^{8} \pm 1.1 \times 10^{9}$
8	2.9 ± 1.9	8.7 ± 5.6	635 ± 408	0.6 ± 0.4	$6.4 \times 10^{8} \pm 4.2 \times 10^{8}$
14	1.4 ± 0.7	4.3 ± 2.0	314 ± 145	0.3 ± 0.1	$3.2 \times 10^{8} \pm 1.1 \times 10^{8}$
24	2.0 ± 0.8	5.9 ± 2.5	428 ± 184	0.4 ± 0.2	$4.2 \times 10^{8} \pm 2.1 \times 10^{8}$
48	2 ± 0.4	4.9 ± 2.1	358 ± 154	0.4 ± 0.1	$4.2 \times 10^{8} \pm 1.1 \times 10^{8}$

[A] per scallop assuming a mass of 73g
[B] ^{14}C-activity measured in water samples by LSC
[C] ^{14}C-activity measured in tissue samples by LSC

Table S2. Kinetic data for uptake and elimination of ^{14}C-labeled *n*PS 24 and 250 nm in the scallop *Pecten maximus*.

		Radiolabeled particles					Algae mixture		
	Size	k_{up} [A]			$t_{1/2}$ [B]	$t_{0.95}$ [C]	k_{up} [A]	$t_{1/2}$ [B]	$t_{0.95}$ [C]
	nm	Bq h^{-1}	mL g^{-1} h^{-1}	mL g^{-1} d^{-1}	h		h^{-1}		h
PS	24	0.5±0.08	6.5 ± 2.5	120-227	2.5	11	0.3±0.05	2.5	10.8
PS	250	0.2±0.01	3.0 ± 0.7	57-91	6.9	29.8	0.7±0.08	1.0	4.4
Control	-	0	0	0	0	0	0.5±0.03	1.5	6.3

[A] Uptake kinetic constant

[B] Time required for the quantity to increase by the half its initial maximum value (i.e. half-life)

[C] Time required for the quantity to increase by 95% of its initial value

Table S3. bioaccumulation kinetic parameters based on the data from the accumulation and depuration period (see table S1).

		Compartment 1					Compartment 2				
	Size nm	C_1[A] %	k_{e1}[B] d^{-1}	$t_{1/2}$[C] d^{-1}	$t_{0.95}$[D] d^{-1}	BCF_{SS1}[E] mL g^{-1}	C_2[A] %	k_{e2}[B] d^{-1}	$t_{1/2}$[C] d^{-1}	$t_{0.95}$[D] d^{-1}	BCF_{SS2}[E] mL g^{-1}
PS	24	88	0.5	1.4	6.2	1192	12	0.02	35	149	3918
PS	250	68	0.5	1.4	6.0	326	32.3	0.01	64.3	278	7228

[A] Percentage in compartment 1 or 2

[B] Elimination kinetic constant for compartment 1 or 2

[C] Time required for the quantity of C_1 or C_2 to reduce to half its initial value (i.e. half-life)

[D] Time required for the quantity of C_1 or C_2 to reduce to 95% its initial

[E] Bioconcentration factor calculated according to Borretzen and Salbu [33].

Table S4. QWBA quantification of *n*PS$_{24}$ after 6h of uptake and 8 days of depuration. Abbreviation: Gi: gills, I: intestine, HP: hepatopancreas, Go: gonad, K: kidney, M: muscle, A: anus.

	6h Uptake			8d depuration		
*n*PS$_{24}$	Bq	ng	µg	Bq	ng	µg
Gi	461.6 ±133	1385.7 ± 400	1.4 ± 0.4	185.6 ± 57	556.8 ± 171	0.5 ± 0.2
I	60.1 ±5.2	226.8 ± 16	0.2 ± 0.02	< MDA		
HP	823.9 ±335	1579.5 ± 35	1.6 ± 0.03	108 ± 10	324.6 ± 31	0.3 ± 0.03
Go	281.6 ±56	913.9 ± 16	0.9 ± 0.02	49.6 ± 32	148.7 ± 97	0.15 ± 0.1
K	196.3 ±154	328.7 ± 15	0.3 ± 0.01	12.0 ± 8	35.9 ± 24	0.03 ± 0.02
M	266.7 ±54	863.0 ± 19	0.9 ± 0.02	49.9 ± 70	149.6 ± 211	0.15 ± 0.2
A	187.7 ±204	163.2 ± 22	0.2 ± 0.02	4.3 ± 6.1	13.0 ± 18.4	0.01 ± 0.02
Total	1558.8 ± 1868	6748.8 ± 2675	6.7 ± 2.7	409.5 ± 185	1228.5 ± 554	1.2 ± 0.5

Equation S1. Minimum detectable activity

$$MDA = \frac{2.71 + 3.29\sqrt{R_b t_S\left[1 + \frac{t_S}{t_b}\right]}}{t_S \times E}$$

MDA = minimum detectable activity in dpm
Rb= background count rate in cpm
ts = sample counting time in minutes
E = detector efficiency in counts per disintegration

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