

Supplementary Online Material

Spatial and seasonal assessment of heavy metal contamination in the sea urchin *Paracentrotus lividus* and the mussel *Mytilus galloprovincialis* from three ports of the Algerian west coast

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Contents

Table S1. Description of the three sampling stations and sampling calendar

Table S2. Number of individuals pooled in each composite sample

Table S3. Quality assurance and quality control of the metal determinations

Table S4. Station effect tested on station–month means: block analysis of variance, linear mixed model, robust tests and residual autocorrelation

Table S5. Homogeneity of regression slopes in the analysis of covariance for body size

Table S6. Raw and partial Pearson correlations between tissue metal concentrations and physico-chemical variables within each station

Dataset S1. Composite-level dataset (Dataset_Benghali_et_al.xlsx)

Code S1. Python scripts reproducing all analyses, tables and figures (Code_S1_scripts.zip)

Table S1. Sampling stations and calendar

Table S1. Description of the single fixed station sampled in each port and calendar of the twelve monthly campaigns (January to December 2025)

Port	Station latitude (°N)	Station longitude	Depth (m)	Substrate	Position and access	Distance to nearest quay (m)	Nearest outfall or source (m)
Oran	35.713479	0.655646 W	1–3	Rocky subtidal (breakwater blocks and natural rock)	Seaward face of the breakwater closest to the harbour; reached from the adjacent shore rocks (access to the enclosed harbour area prohibited)	800	500
Arzew	35.861618	0.296149 W	1–3	Rocky subtidal (breakwater blocks and natural rock)	Seaward face of the breakwater closest to the harbour; reached from the adjacent shore rocks (access to the enclosed harbour area prohibited)	1200	650
Mostaganem	35.931278	0.073067 E	1–3	Rocky subtidal (breakwater blocks and natural rock)	Seaward face of the breakwater closest to the harbour; reached from the adjacent shore rocks (access to the enclosed harbour area prohibited)	500	900

Note: Coordinates in decimal degrees, WGS 84, of the fixed sampling point of each station (the point at which both species and the water replicates were collected). Sea urchins were collected at 1–3 m depth and mussels on the intertidal fringe of the same hard substrate. Distances are measured on the harbour plan. No permit is required for the collection of these non-protected invertebrates in the quantities taken, and the stations lie outside the restricted harbour areas; no ethical approval applies to these species.

Table S1 (continued). Sampling calendar and field conditions of the twelve monthly campaigns (2025)

Month	Sampling day	Time window (local)	Organisation of the three stations	Sea state and wind
January	Sunday or Monday of the first week (5–6 Jan)	07:30–11:00	One team, stations visited in turn	Calm to slightly rough; light WNW wind
February	Sunday or Monday of the first week (2–3 Feb)	07:30–11:00	One team, stations visited in turn	Calm to slightly rough; light WNW wind
March	Sunday or Monday of the first week (2–3 Mar)	07:30–11:00	Three teams, simultaneous	Calm to slightly rough; light WNW wind
April	Sunday or Monday of the first week (6–7 Apr)	07:30–11:00	Three teams, simultaneous	Calm to slightly rough; light WNW wind
May	Sunday or Monday of the first week (4–5 May)	07:30–11:00	Three teams, simultaneous	Calm to slightly rough; light WNW wind
June	Sunday or Monday of the first week (1–2 Jun)	07:30–11:00	Three teams, simultaneous	Calm to slightly rough; light WNW wind
July	Sunday or Monday of the first week (6–7 Jul)	07:30–11:00	One team, stations visited in turn	Calm to slightly rough; light WNW wind
August	Sunday or Monday of the first week (3–4 Aug)	07:30–11:00	One team, stations visited in turn	Calm to slightly rough; light WNW wind
September	Sunday or Monday of the first week (1 or 7 Sep)	07:30–11:00	One team, stations visited in turn	Calm to slightly rough; light WNW wind
October	Sunday or Monday of the first week (5–6 Oct)	07:30–11:00	One team, stations visited in turn	Calm to slightly rough; light WNW wind
November	Sunday or Monday of the first week (2–3 Nov)	07:30–11:00	One team, stations visited in turn	Calm to slightly rough; light WNW wind
December	Sunday or Monday of the first week (1 or 7 Dec)	07:30–11:00	One team, stations visited in turn	Calm to slightly rough; light WNW wind

Note: All campaigns were carried out in the morning on the Sunday or Monday of the first week of the month, so that the two species and the three water replicates of a station were collected on the same visit. From March to June 2025 the three stations were sampled simultaneously by three teams (the authors and trained Master's students) following the same written protocol; in the other months a single team visited the three stations in turn on the same or the following day. Field conditions were recorded qualitatively at each visit.

Table S1 (continued). In situ instruments, calibration procedure and reference standards used for the physico-chemical measurements

Parameter	Instrument / method	Calibration procedure and frequency	Reference standards
Temperature, pH	Portable multi-parameter meter WTW Multi 3630 IDS with pH/temperature sensor (pH $\pm$ 0.005; temperature $\pm$ 0.1 °C)	pH: two- or three-point calibration before each campaign; temperature: annual check against a calibrated reference thermometer	Certified pH buffers 4.01, 7.01 and 10.01; calibrated reference thermometer
Dissolved oxygen	Optical (luminescent) oxygen sensor WTW FDO 925 on the same meter ($\pm$ 0.1 mg L ⁻¹ or $\pm$ 1% of reading)	Calibration before each campaign: 100% in water-saturated air; zero check	Water-saturated air; 0% oxygen solution (sodium sulfite/bisulfite)
Salinity	Hand-held refractometer Atago Master-S/Mill M with automatic temperature compensation ($\pm$ 1)	Zero check with distilled water before each series of measurements; verification against a standard solution	Distilled or demineralised water (zero); standard saline solution (35)
Turbidity	Portable nephelometer WTW Turb 430 IR ($\pm$ 2% of reading)	Monthly calibration, i.e. before each campaign; verification standard checked before measurement	Polymer (AMCO Clear) turbidity standards, 0.02, 10, 100 and 800 NTU
Suspended particulate matter	Gravimetry: 0.45 μ m membrane filters, pre-dried and pre-weighed; drying oven at 105 °C; analytical balance Mettler Toledo ME204 (readability 0.1 mg)	Balance: automatic internal adjustment daily and periodic verification with certified weights; oven temperature checked annually with a calibrated Pt100 probe; filtered volume measured for each sample	Certified calibration weights (class E2/F1); calibrated Pt100 probe

Note: Each water parameter was measured in three replicates at the point where the corresponding composite sample was collected (see Methods, pairing rule). Manufacturer specifications are given in parentheses. Suspended particulate matter followed the direct gravimetric method (EN 872).

Table S2. Individuals per composite sample

Table S2. Number of individuals pooled in each composite sample, by species, station and month. The three replicate composites of a given species, station and month contained the same number of individuals

Month	<i>P. lividus</i> Oran	<i>P. lividus</i> Arzew	<i>P. lividus</i> Mostaganem	<i>M. galloprovincialis</i> Oran	<i>M. galloprovincialis</i> Arzew	<i>M. galloprovincialis</i> Mostaganem
January	26	28	22	28	24	22
February	30	21	27	28	25	25
March	23	20	20	20	23	30
April	20	20	20	24	22	24
May	24	23	23	26	25	27
June	27	28	30	20	29	23
July	23	25	26	30	28	30
August	28	20	29	30	24	28
September	28	25	30	23	23	30
October	25	26	23	30	23	27
November	26	29	29	20	20	20
December	29	24	26	29	29	28
Total per composite series	309	289	305	308	295	314
Total individuals (× 3 replicates)	927	867	915	924	885	942

Note: Grand total: 2,709 *P. lividus* and 2,751 *M. galloprovincialis*, 5,460 individuals. Values are also given for every composite sample in Dataset S1 (column "Nombre_individus_échantillonnés").

Table S3. Quality assurance and quality control

Table S3. Certified reference materials, recoveries, detection and quantification limits and precision of the flame, electrothermal and cold-vapour atomic absorption determinations (GBC Avanta 932 with FIMS-100 mercury unit)

Element	Technique	Wavelength (nm)	CRM	Certified value ± U (k = 2) (mg kg ⁻¹ dw)	Recovery in every batch (%)	LOD (mg kg ⁻¹)	LOQ (mg kg ⁻¹)	Replicate RSD (%)
Hg	CV-AAS	253.7	ERM-CE278k	0.071 ± 0.007	within 92–108	0.002	0.007	< 8
Hg	CV-AAS	253.7	IAEA-452	0.16 ± 0.02	within 92–108	0.002	0.007	< 8
Cd	GF-AAS	228.8	ERM-CE278k	0.336 ± 0.025	within 92–108	0.001	0.003	< 8
Cd	GF-AAS	228.8	IAEA-452	30.5 ± 1.6	within 92–108	0.001	0.003	< 8
Pb	GF-AAS	217.0	ERM-CE278k	2.18 ± 0.18	within 92–108	0.005	0.017	< 8
Pb	GF-AAS	217.0	IAEA-452	2.4 ± 0.3	within 92–108	0.005	0.017	< 8
Cu	F-AAS	324.7	ERM-CE278k	5.98 ± 0.27	within 92–108	0.010	0.033	< 8
Cu	F-AAS	324.7	IAEA-452	11.0 ± 0.8	within 92–108	0.010	0.033	< 8
Zn	F-AAS	213.9	ERM-CE278k	71 ± 4	within 92–108	0.050	0.167	< 8
Zn	F-AAS	213.9	IAEA-452	167 ± 10	within 92–108	0.050	0.167	< 8

Note: ERM-CE278k – mussel tissue, JRC Institute for Reference Materials and Measurements, Geel (certificate accepted 22 October 2012, revised October 2013; certified mass fractions expressed on dry mass, minimum sample intake 200 mg); IAEA-452 – freeze-dried soft tissue (gills, mantle and digestive gland) of the scallop *Pecten maximus*, IAEA Environment Laboratories, Reference Sheet RS_IAEA-452 Rev. 03 (2020-10-01); certified values are medians of the accepted inter-

laboratory data sets, U is the expanded uncertainty ($k = 2$), and the minimum test portion is 0.2 g, respected by the 0.25 g test portions used here. Certified values are those of the certificates. One aliquot of reference material was digested and analysed with every batch of twenty samples; a batch was accepted only if the recovery of every element fell within 92–108% of the certified value and the triplicate RSD was below 8%, and all batches of the campaign met these criteria, as attested in the analytical quality statement signed by the Chair of the Faculty Scientific Council (Ref. N°18/02/Eng/CSF-SNV/2026, supplied as a separate file). The individual batch recoveries were recorded on the instrument printouts and control sheets used for batch acceptance and are not archived in a machine-readable form; the acceptance range is therefore reported rather than element-by-element means. LOD = 3 SD of the blanks; LOQ = 10 SD of the blanks; dw – dry weight.

Table S3 (continued). Analytical batch control

Item	Description
Sample preparation	Freeze-drying at -55°C for 48 h (Christ Alpha 1-2 LD plus); homogenisation in an agate mortar; about 0.25 g dry mass digested with 7 mL HNO_3 (67–69%, Suprapur) and 1 mL H_2O_2 (30%, Suprapur) in closed PFA vessels (Anton Paar Multiwave PRO; 10 min ramp to 180°C , 15 min at 180°C and 35 bar, 20 min cooling); final volume 50 mL
Calibration	Certified single- and multi-element stock solutions ($1,000\text{ mg L}^{-1}$), matrix-matched to the digestion medium; working ranges $0\text{--}5\text{ }\mu\text{g L}^{-1}$ (Hg, Cd), $0\text{--}20\text{ }\mu\text{g L}^{-1}$ (Pb), $0\text{--}5\text{ mg L}^{-1}$ (Cu), $0\text{--}2\text{ mg L}^{-1}$ (Zn); $r^2 \geq 0.999$ for every element; calibration verified periodically during each analytical run
Reference materials analysed	One aliquot of certified reference material digested and analysed with every batch of twenty samples throughout the campaign
Recovery and batch acceptance	Within 92–108% of the certified value for the five elements in every batch; batches outside this range would have been re-digested and re-analysed, which was not required during the campaign (signed laboratory statement Ref. N°18/02/Eng/CSF-SNV/2026)
Identification of the reference materials	IAEA-452: single production batch supplied in 8 g bottles (no lot number), Reference Sheet RS_IAEA-452 Rev. 03 (2020-10-01); ERM-CE278k: JRC certificate revised October 2013, certification report EUR 25523 EN, supplied in 8 g vials (JRC, Geel)
Procedural blanks	Twelve blanks carried through the full digestion protocol; all below the limit of detection; LOD = 3 SD of the blanks, LOQ = $(10/3) \times \text{LOD}$
Replicate determinations	Every sample analysed in triplicate; relative standard deviation between replicates below 8%
Non-validated data	Four copper values (0.37% of 1,080 determinations) could not be validated and were excluded, not imputed
Matrix spike on urchin tissue	Not performed; the absence of a matrix-specific bias for <i>P. lividus</i> is inferred from the bivalve reference materials only
Expanded measurement uncertainty	Not estimated formally; the recovery acceptance range and the replicate RSD are the available indicators of accuracy and precision, and the certified uncertainties ($k = 2$) of the reference materials are given above
Moisture content of tissues	Not determined; all results are expressed on a dry-weight basis and no conversion to wet weight is possible

Table S4. Station effect on station–month means and robustness

Table S4. Station effect tested on station–month means ($n = 36$ per species): analysis of variance with month as a blocking factor, linear mixed model with station and season as fixed effects and month as a random intercept, heteroscedasticity-robust and rank-based tests on the composite data, and lag-1 autocorrelation of the station residuals

Species	Metal	Block ANOVA F(2,22)	p	$\eta^2\text{p}$	Shapiro p	LMM χ^2 station	LMM χ^2 season	Welch F	Kruskal–Wallis H	$\log_{10}$ ANOVA F	Levene p (log)	Lag-1 r (min; mean; max)
<i>P. lividus</i>	Cd	90.9	<0.001	0.89	0.92	182	23.0	52.6	58.3	105.0	0.30	0.00; 0.16; 0.36
<i>P. lividus</i>	Pb	98.3	<0.001	0.90	0.39	197	17.3	62.9	63.2	108.6	0.45	-0.30; 0.03; 0.35
<i>P. lividus</i>	Cu	137.7	<0.001	0.93	0.89	275	19.2	60.3	60.2	95.6	0.92	-0.22; -0.02; 0.13
<i>P. lividus</i>	Zn	119.5	<0.001	0.92	0.90	239	19.6	63.6	61.7	100.5	0.98	-0.39; 0.05; 0.35

Species	Metal	Block ANOVA F(2,22)	p	η^2p	Shapiro p	LMM χ^2 station	LMM χ^2 season	Welch F	Kruskal–Wallis H	$\log_{10}$ ANOVA F	Levene p (log)	Lag-1 r (min; mean; max)
<i>P. lividus</i>	Hg	75.3	<0.001	0.87	0.95	151	19.8	53.4	57.4	82.0	0.35	-0.29; -0.01; 0.26
<i>M. galloprovincialis</i>	Cd	136.9	<0.001	0.93	0.24	274	18.7	79.3	67.1	115.3	0.79	-0.27; 0.07; 0.39
<i>M. galloprovincialis</i>	Pb	152.7	<0.001	0.93	0.66	305	18.6	81.5	68.2	126.8	0.91	-0.25; 0.08; 0.45
<i>M. galloprovincialis</i>	Cu	139.6	<0.001	0.93	0.29	279	22.5	90.6	69.2	137.7	0.94	-0.41; 0.03; 0.36
<i>M. galloprovincialis</i>	Zn	157.4	<0.001	0.93	0.72	315	17.5	85.5	69.0	131.0	0.88	-0.07; 0.17; 0.39
<i>M. galloprovincialis</i>	Hg	158.0	<0.001	0.93	0.50	316	21.5	87.0	71.4	145.1	0.20	-0.17; 0.10; 0.27

Note: All station effects (block ANOVA, LMM, Welch, Kruskal–Wallis, $\log_{10}$ ANOVA) $p < 0.001$; all LMM season effects $p < 0.001$. η^2p of the block model = $SS(\text{station}) / (SS(\text{station}) + SS(\text{residual}))$. Shapiro p refers to the residuals of the block model. Welch F uses the composite data ($df_1 = 2$). Lag-1 r is the autocorrelation of consecutive monthly residuals within each station after removal of the station means (three values per species–metal combination).

Table S5. Homogeneity of regression slopes (ANCOVA)

Table S5. Test of the station $\times$ size interaction in the analysis of covariance of tissue metal concentration on station, season and mean body size of the composite sample (test diameter for *P. lividus*, shell length for *M. galloprovincialis*)

Species	Metal	F (station $\times$ size)	p	Conclusion
<i>P. lividus</i>	Cd	0.12	0.884	Homogeneous
<i>P. lividus</i>	Pb	0.01	0.994	Homogeneous
<i>P. lividus</i>	Cu	0.23	0.792	Homogeneous
<i>P. lividus</i>	Zn	0.06	0.941	Homogeneous
<i>P. lividus</i>	Hg	0.27	0.765	Homogeneous
<i>M. galloprovincialis</i>	Cd	2.35	0.100	Homogeneous
<i>M. galloprovincialis</i>	Pb	3.51	0.034	Heterogeneous – interpret adjusted effect with caution
<i>M. galloprovincialis</i>	Cu	1.35	0.263	Homogeneous
<i>M. galloprovincialis</i>	Zn	2.75	0.069	Homogeneous
<i>M. galloprovincialis</i>	Hg	1.62	0.203	Homogeneous

Note: $df = 2, 98$ (2, 94 for copper in *P. lividus*). The homogeneity of slopes is a prerequisite for the adjusted station effect reported in the main text; it is met for nine of ten combinations.

Table S6. Correlations with physico-chemical variables

Table S6. Raw and partial Pearson correlations between tissue metal concentrations and physico-chemical variables within each station ($n = 72$ paired composite–water observations, both species). Partial coefficients are computed after removing the species and season effects from both variables; q is the Benjamini–Hochberg adjusted p over the 30 tests of the station

Station	Metal	Variable	r (raw)	p	q	r (partial)	p	q
Oran	Cd	Temperature	0.46	<0.001	<0.001	0.56	<0.001	<0.001
Oran	Cd	Salinity	0.01	0.951	0.951	-0.17	0.151	0.181
Oran	Cd	DO	-0.32	0.006	0.012	-0.25	0.038	0.063
Oran	Cd	pH	-0.04	0.759	0.951	-0.07	0.575	0.663
Oran	Cd	Turbidity	0.42	<0.001	<0.001	0.39	<0.001	0.002
Oran	Cd	SPM	0.42	<0.001	<0.001	0.48	<0.001	<0.001
Oran	Pb	Temperature	0.49	<0.001	<0.001	0.58	<0.001	<0.001
Oran	Pb	Salinity	-0.03	0.835	0.951	-0.22	0.060	0.090
Oran	Pb	DO	-0.32	0.006	0.012	-0.24	0.043	0.068

Station	Metal	Variable	r (raw)	p	q	r (partial)	p	q
Oran	Pb	pH	-0.01	0.900	0.951	-0.03	0.796	0.796
Oran	Pb	Turbidity	0.42	<0.001	<0.001	0.38	0.001	0.002
Oran	Pb	SPM	0.44	<0.001	<0.001	0.50	<0.001	<0.001
Oran	Cu	Temperature	0.62	<0.001	<0.001	0.58	<0.001	<0.001
Oran	Cu	Salinity	-0.03	0.832	0.951	-0.22	0.063	0.091
Oran	Cu	DO	-0.42	<0.001	<0.001	-0.26	0.032	0.056
Oran	Cu	pH	0.03	0.810	0.951	0.05	0.684	0.708
Oran	Cu	Turbidity	0.54	<0.001	<0.001	0.36	0.002	0.004
Oran	Cu	SPM	0.56	<0.001	<0.001	0.46	<0.001	<0.001
Oran	Zn	Temperature	0.28	0.018	0.032	0.49	<0.001	<0.001
Oran	Zn	Salinity	-0.01	0.914	0.951	-0.20	0.096	0.120
Oran	Zn	DO	-0.19	0.114	0.170	-0.20	0.084	0.115
Oran	Zn	pH	-0.02	0.844	0.951	-0.06	0.637	0.705
Oran	Zn	Turbidity	0.25	0.035	0.055	0.34	0.004	0.007
Oran	Zn	SPM	0.26	0.028	0.046	0.43	<0.001	<0.001
Oran	Hg	Temperature	0.44	<0.001	<0.001	0.61	<0.001	<0.001
Oran	Hg	Salinity	-0.01	0.946	0.951	-0.20	0.096	0.120
Oran	Hg	DO	-0.31	0.008	0.015	-0.28	0.017	0.031
Oran	Hg	pH	-0.03	0.775	0.951	-0.05	0.658	0.705
Oran	Hg	Turbidity	0.40	<0.001	0.001	0.44	<0.001	<0.001
Oran	Hg	SPM	0.39	<0.001	0.002	0.43	<0.001	<0.001
Arzew	Cd	Temperature	0.33	0.005	0.022	0.17	0.153	0.511
Arzew	Cd	Salinity	-0.04	0.727	0.872	-0.14	0.235	0.613
Arzew	Cd	DO	-0.25	0.031	0.063	-0.01	0.921	0.992
Arzew	Cd	pH	-0.08	0.525	0.716	-0.05	0.674	0.919
Arzew	Cd	Turbidity	0.30	0.010	0.027	0.18	0.130	0.511
Arzew	Cd	SPM	0.29	0.013	0.032	0.07	0.552	0.908
Arzew	Pb	Temperature	0.37	0.001	0.010	0.20	0.087	0.511
Arzew	Pb	Salinity	-0.02	0.850	0.929	-0.10	0.393	0.766
Arzew	Pb	DO	-0.27	0.020	0.043	-0.00	0.979	0.992
Arzew	Pb	pH	-0.05	0.686	0.857	0.02	0.893	0.992
Arzew	Pb	Turbidity	0.35	0.003	0.016	0.22	0.058	0.511
Arzew	Pb	SPM	0.33	0.005	0.022	0.10	0.420	0.766
Arzew	Cu	Temperature	0.45	<0.001	0.001	0.15	0.210	0.613
Arzew	Cu	Salinity	0.05	0.671	0.857	0.03	0.808	0.992
Arzew	Cu	DO	-0.31	0.009	0.027	0.09	0.434	0.766
Arzew	Cu	pH	-0.08	0.517	0.716	0.00	0.988	0.992
Arzew	Cu	Turbidity	0.42	<0.001	0.003	0.19	0.109	0.511
Arzew	Cu	SPM	0.45	<0.001	0.001	0.13	0.279	0.613
Arzew	Zn	Temperature	0.21	0.077	0.130	0.17	0.151	0.511
Arzew	Zn	Salinity	-0.01	0.960	0.994	-0.07	0.580	0.908
Arzew	Zn	DO	-0.16	0.184	0.277	-0.01	0.952	0.992
Arzew	Zn	pH	-0.03	0.782	0.902	-0.00	0.992	0.992
Arzew	Zn	Turbidity	0.21	0.078	0.130	0.24	0.041	0.511
Arzew	Zn	SPM	0.20	0.095	0.151	0.13	0.286	0.613
Arzew	Hg	Temperature	0.31	0.009	0.027	0.19	0.109	0.511
Arzew	Hg	Salinity	0.00	0.997	0.997	-0.05	0.654	0.919
Arzew	Hg	DO	-0.23	0.047	0.089	-0.02	0.897	0.992
Arzew	Hg	pH	-0.02	0.867	0.929	0.06	0.605	0.908
Arzew	Hg	Turbidity	0.28	0.017	0.039	0.18	0.122	0.511
Arzew	Hg	SPM	0.30	0.010	0.027	0.14	0.255	0.613
Mostaganem	Cd	Temperature	0.46	<0.001	<0.001	0.47	<0.001	<0.001

Station	Metal	Variable	r (raw)	p	q	r (partial)	p	q
Mostaganem	Cd	Salinity	-0.09	0.469	0.521	-0.05	0.702	0.752
Mostaganem	Cd	DO	-0.42	<0.001	<0.001	-0.42	<0.001	0.002
Mostaganem	Cd	pH	0.16	0.189	0.270	0.08	0.512	0.615
Mostaganem	Cd	Turbidity	0.25	0.031	0.079	0.13	0.285	0.503
Mostaganem	Cd	SPM	0.18	0.130	0.216	0.12	0.327	0.517
Mostaganem	Pb	Temperature	0.42	<0.001	<0.001	0.38	0.001	0.004
Mostaganem	Pb	Salinity	-0.05	0.693	0.717	0.02	0.858	0.888
Mostaganem	Pb	DO	-0.39	<0.001	0.002	-0.38	0.001	0.004
Mostaganem	Pb	pH	0.16	0.187	0.270	0.07	0.542	0.626
Mostaganem	Pb	Turbidity	0.25	0.037	0.087	0.13	0.281	0.503
Mostaganem	Pb	SPM	0.24	0.047	0.093	0.22	0.058	0.146
Mostaganem	Cu	Temperature	0.51	<0.001	<0.001	0.42	<0.001	0.002
Mostaganem	Cu	Salinity	-0.06	0.597	0.640	0.05	0.659	0.732
Mostaganem	Cu	DO	-0.53	<0.001	<0.001	-0.54	<0.001	<0.001
Mostaganem	Cu	pH	0.11	0.368	0.456	-0.08	0.496	0.615
Mostaganem	Cu	Turbidity	0.26	0.028	0.079	0.08	0.483	0.615
Mostaganem	Cu	SPM	0.21	0.085	0.159	0.10	0.408	0.612
Mostaganem	Zn	Temperature	0.25	0.031	0.079	0.36	0.002	0.006
Mostaganem	Zn	Salinity	-0.03	0.789	0.789	-0.00	0.981	0.981
Mostaganem	Zn	DO	-0.24	0.046	0.093	-0.36	0.002	0.006
Mostaganem	Zn	pH	0.10	0.395	0.456	0.15	0.217	0.465
Mostaganem	Zn	Turbidity	0.15	0.213	0.291	0.12	0.303	0.505
Mostaganem	Zn	SPM	0.11	0.357	0.456	0.13	0.259	0.503
Mostaganem	Hg	Temperature	0.45	<0.001	<0.001	0.37	0.001	0.004
Mostaganem	Hg	Salinity	-0.10	0.384	0.456	-0.08	0.480	0.615
Mostaganem	Hg	DO	-0.43	<0.001	<0.001	-0.43	<0.001	0.002
Mostaganem	Hg	pH	0.19	0.118	0.209	0.15	0.210	0.465
Mostaganem	Hg	Turbidity	0.34	0.003	0.011	0.32	0.006	0.017
Mostaganem	Hg	SPM	0.17	0.153	0.242	0.09	0.429	0.613

Note: DO – dissolved oxygen; SPM – suspended particulate matter. Coefficients with $q < 0.05$ are those marked with an asterisk in Figure 6 of the main text (partial coefficients).

Dataset S1 and Code S1

Dataset S1 (Dataset_Benghali_et_al.xlsx) contains the complete composite-level data in five sheets (column headings in French): *Metaux_lourds* – for each of the 216 composite samples, species, station, month, replicate number, number of individuals pooled and the concentrations of Cd, Pb, Cu, Zn and Hg (mg kg^{-1} dry weight); *Biometrie_Oursin* and *Biometrie_Moule* – mean test diameter or shell length, mean total wet weight, gonadosomatic index (*P. lividus*) and condition index of each composite; *Physico_chimie* – the paired water measurements (temperature, salinity, dissolved oxygen, pH, turbidity, suspended particulate matter) for each station, month and replicate, replicate k being paired with composite k of the same station and date; *QC_Controlle_Qualite* – the internal consistency checks applied to the dataset. Individual measurements were not archived separately.

Code S1 (Code_S1_scripts.zip) contains the Python 3 scripts that reproduce every statistic, table and figure of the manuscript from Dataset S1: *compute_stats.py* (descriptive statistics, composite-level two-way ANOVA, Tukey tests, species comparison, allometry), *compute_extra_stats.py* (assumption checks, partial eta squared, ANCOVA), *compute_revision_stats.py* (station-month means, block ANOVA, linear mixed models, robust tests, slope homogeneity, species mixed model, partial correlations with false-discovery-rate correction, autocorrelation), *make_figures.py*,

`make_fig_corr_rev.py` and `make_mpi_fig.py` (Figures 1–7), and `build_eet_rev.py` (assembly of the manuscript). Dependencies: `pandas`, `numpy`, `scipy`, `statsmodels`, `matplotlib`.