

***Polycarpa aurata* as biomonitor to assess potential toxic elements across the Coral Triangle**  
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**SUPPLEMENTARY INFORMATION**

**Table S1. Impact and control sampling sites, their respective acronyms, the related kind of mining activity, and the geographical coordinates (Datum WGS84).**

Site name	Acronym	Type of mining	Latitude °N	Longitude °E
Totok Bay	TB	Artisanal gold mine (1850s - ongoing)	0.87699	124.76205
Talawaan River	TW	Artisanal gold mine (1997 - ongoing)	1.61735	124.86764
Pantai Surabaya	PS	Industrial gold mine (2010 - ongoing)	1.66839	125.10824
Coral Eye	CE	Mining site in preparation (2014-2017)	1.75073	125.13345
Batu Belah	BB	None	1.77248	125.18230
Batu Nona	BN	None	1.35379	125.08017
Talisei Island	TA	None	1.85415	125.08999
Tasik Ria Resort	TR	None	1.41322	124.70601

**Table S2. Instrumental operating conditions for ICP-MS.**

Instrument	Agilent 7700x ICP-MS
RF power	1550 W
RF matching	1.8 V
Plasma gas flow rate	15 l min <sup>-1</sup> Ar
Auxiliary gas flow rate	1.0 l min <sup>-1</sup> Ar
Carrier gas flow rate	1.05 l min <sup>-1</sup> Ar
Make-up gas flow rate	0.0 l min <sup>-1</sup> Ar
He gas flow	4.3 ml min <sup>-1</sup>
CeO <sup>+</sup> /Ce <sup>+</sup>	0.902%
Ratio (2+) 70/140	0.944%
Nebulizer	Microflow PFA
Spray chamber	Scott double-pass type at 2 °C
Torch	Quartz glass torch
Sample uptake rate	0.1 ml min <sup>-1</sup>
Sample cone Nickel	1.0 mm aperture i.d.
Skimmer cone Nickel	0.5 mm aperture i.d.
Sampling depth	8.5 mm
Detector mode	Dual (pulse and analog counting)
Dwell time/mass	1000 ms
Replicate	9

**Table S3.1 Summary of PERMANOVA test on selected trace elements mean concentrations ( $\mu\text{g kg}^{-1}$  dry weight) in the suspended particulate matter at Totok Bay (TB) vs. Control and among sites nested in Impact  $\times$  Control. When less than 100 unique permutations were available, the asymptotic Monte Carlo p-value was used instead of the permutational one. When no significant differences in mean element concentrations were found among control sites ( $p > 0.25$ ), the site data was pooled to increase degrees of freedom for the main test denominator to 13. Significant levels were indicated by the following symbols: ns = not significant; \* =  $p < 0.05$ ; \*\* =  $p < 0.01$ ; \*\*\* =  $p < 0.001$ .**

	Totok Bay vs. Control						Sites (Totok Bay $\times$ Control)					Res MS	
	MS	p F1,3	p (perm)	N. perm	p (MC)		MS	p F3,10	p (perm)	N. perm	p (MC)		
<b>Hg</b>	0.045	3977	0.003	8	0.000	***	1E-05	<i>Pooled</i>					
<b>Al</b>	3E+07	0.274	0.599	5	0.635	ns	1E+08	1.917	0.185	9956	0.192	ns	5E+07
<b>As</b>	0.300	0.041	1.000	5	0.853	ns	7.314	2.540	0.112	9955	0.114	ns	2.880
<b>Ba</b>	2E+07	0.145	0.704	455	0.709	ns	1E+08	<i>Pooled</i>					
<b>Cr</b>	2.682	0.198	0.796	5	0.682	ns	13.52	2.247	0.159	9948	0.143	ns	6.016
<b>Cu</b>	9.090	0.288	0.596	5	0.624	ns	31.61	2.214	0.145	9958	0.149	ns	14.28
<b>Fe</b>	6E+06	0.607	0.605	5	0.488	ns	1E+07	14.16	0.001	9954	0.001	***	7E+05
<b>Mn</b>	1410	0.015	1.000	5	0.907	ns	92647	20.61	0.000	9945	0.000	***	4494.8
<b>Mo</b>	4E+06	0.469	0.399	5	0.538	ns	8E+06	11.95	0.000	9944	0.001	**	6E+05
<b>Sb</b>	0.094	5.636	0.028	453	0.035	*	0.017	<i>Pooled</i>					
<b>V</b>	20.37	0.327	0.798	5	0.609	ns	62.31	11.10	0.003	9954	0.002	**	5.613
<b>Zn</b>	8E+06	0.129	0.750	455	0.719	ns	6E+07	<i>Pooled</i>					

**Table S3.2 Summary of PERMANOVA test on selected trace elements mean concentrations ( $\mu\text{g kg}^{-1}$  dry weight) in the suspended particulate matter at Talawaan River (TW) vs. Control and among sites nested in Impact  $\times$  Control. When less than 100 unique permutations were available, the asymptotic Monte Carlo p-value was used instead of the permutational one. When no significant differences in mean element concentrations were found among control sites ( $p > 0.25$ ), the site data was pooled to increase degrees of freedom for the main test denominator to 13. Significant levels were indicated by the following symbols: ns = not significant; \* =  $p < 0.05$ ; \*\* =  $p < 0.01$ ; \*\*\* =  $p < 0.001$ .**

	Talawaan River vs. Control						Sites (Talawaan River $\times$ Control)					Res MS	
	MS	p F1,3	p (perm)	N. perm	p (MC)		MS	p F3,10	p (perm)	N. perm	p (MC)		
<b>Hg</b>	0.023	104.1	0.003	8	0.000	***	0.000	<i>Pooled</i>					
<b>Al</b>	8E+08	11.39	0.013	455	0.005	**	7E+07	<i>Pooled</i>					
<b>As</b>	11.03	1.508	0.404	5	0.311	ns	7.314	1.853	0.196	9955	0.202	ns	3.947
<b>Ba</b>	9E+08	6.425	0.027	455	0.024	*	1E+08	<i>Pooled</i>					
<b>Cr</b>	0.6285	0.047	1.000	5	0.841	ns	13.52	2.514	0.131	9952	0.114	ns	5.375
<b>Cu</b>	117.72	4.861	0.047	455	0.045	*	24.22	<i>Pooled</i>					
<b>Fe</b>	3E+08	41.20	0.003	452	0.000	***	8E+06	<i>Pooled</i>					
<b>Mn</b>	2E+06	17.49	0.193	5	0.028	*	92647	2.047	0.155	9942	0.169	ns	45251
<b>Mo</b>	4E+06	0.478	0.398	5	0.532	ns	8E+06	11.92	0.001	9935	0.001	**	6E+05
<b>Sb</b>	0.040	0.896	0.370	453	0.362	ns	0.044	<i>Pooled</i>					
<b>V</b>	1236	19.83	0.197	5	0.022	*	62.31	2.187	0.141	9955	0.153	ns	28.49
<b>Zn</b>	3E+08	5.001	0.034	454	0.041	*	7E+07	<i>Pooled</i>					

**Table S3.3 Summary of PERMANOVA test on selected trace elements mean concentrations ( $\mu\text{g kg}^{-1}$  dry weight) in the suspended particulate matter at Pantai Surabaya (PS) vs. Control and among sites nested in Impact  $\times$  Control. When less than 100 unique permutations were available, the asymptotic Monte Carlo p-value was used instead of the permutational one. When no significant differences in mean element concentrations were found among control sites ( $p > 0.25$ ), the site data was pooled to increase degrees of freedom for the main test denominator to 13. Significant levels were indicated by the following symbols: ns = not significant; \* =  $p < 0.05$ ; \*\* =  $p < 0.01$ ; \*\*\* =  $p < 0.001$ .**

	Pantai Surabaya vs. Control					Sites (Pantai Surabaya $\times$ Control)					Res MS		
	MS	p F1,3	p (perm)	N. perm	p (MC)	MS	p F3,10	p (perm)	N. perm	p (MC)			
<b>Hg</b>	<i>No test</i>												
<b>Al</b>	8E+07	1.091	0.316	455	0.320	ns	8E+07	<i>Pooled</i>					
<b>As</b>	2.264	0.310	1.000	5	0.610	ns	7.314	2.148	0.155	9956	0.153	ns	3.405
<b>Ba</b>	3E+08	3.088	0.083	455	0.104	ns	1E+08	<i>Pooled</i>					
<b>Cr</b>	4.713	0.349	0.601	5	0.600	ns	13.52	1.721	0.237	9935	0.227	ns	7.853
<b>Cu</b>	370.0	11.706	0.203	5	0.041	*	31.61	2.201	0.145	9952	0.145	ns	14.36
<b>Fe</b>	6E+07	5.782	0.199	5	0.097	ns	1E+07	9.241	0.006	9942	0.003	**	1E+06
<b>Mn</b>	1E+06	13.975	0.194	5	0.034	*	92647	3.797	0.045	9947	0.050	ns	2E+04
<b>Mo</b>	4E+06	0.504	0.402	5	0.527	ns	8E+06	11.84	0.001	9947	0.001	**	7E+05
<b>Sb</b>	0.033	1.825	0.180	455	0.192	ns	0.018	<i>Pooled</i>					
<b>V</b>	530.2	8.509	0.199	5	0.062	ns	62.31	6.778	0.013	9960	0.009	**	9.194
<b>Zn</b>	1E+06	0.015	0.923	455	0.901	ns	8E+07	<i>Pooled</i>					

**Table S3.4 Summary of PERMANOVA test on selected trace elements mean concentrations ( $\mu\text{g kg}^{-1}$  dry weight) in the suspended particulate matter at Coral Eye (CE) vs. Control and among sites nested in Impact  $\times$  Control. When less than 100 unique permutations were available, the asymptotic Monte Carlo p-value was used instead of the permutational one. When no significant differences in mean element concentrations were found among control sites ( $p > 0.25$ ), the site data was pooled to increase degrees of freedom for the main test denominator to 13. Significant levels were indicated by the following symbols: ns = not significant; \* =  $p < 0.05$ ; \*\* =  $p < 0.01$ ; \*\*\* =  $p < 0.001$ .**

	Coral Eye vs. Control					Sites (Coral Eye $\times$ Control)					Res		
	MS	p F1,3	p (perm)	N. perm	p (MC)	MS	p F3,10	p (perm)	N. perm	p (MC)	MS		
<b>Hg</b>	<i>No test</i>												
<b>Al</b>	2E+06	0.033	0.889	455	0.860	ns	7E+07	<i>Pooled</i>					
<b>As</b>	7.650	1.046	0.595	5	0.373	ns	7.314	1.954	0.182	9955	0.187	ns	3.743
<b>Ba</b>	1E+07	0.100	0.755	454	0.760	ns	1E+08	<i>Pooled</i>					
<b>Cr</b>	0.629	0.047	0.595	5	0.845	ns	13.52	1.957	0.204	9944	0.186	ns	6.905
<b>Cu</b>	32.22	1.019	0.603	5	0.390	ns	31.61	2.075	0.166	9949	0.166	ns	15.23
<b>Fe</b>	5E+06	0.557	0.803	5	0.509	ns	1E+07	12.61	0.002	9958	0.001	**	8E+05
<b>Mn</b>	23868	0.258	0.594	5	0.641	ns	92647	20.81	0.000	9942	0.000	***	4451
<b>Mo</b>	6E+05	0.076	0.603	5	0.797	ns	8E+06	10.96	0.002	9943	0.002	**	7E+05
<b>Sb</b>	0.046	2.538	0.114	455	0.132	ns	0.018	<i>Pooled</i>					
<b>V</b>	48.65	0.781	0.801	5	0.449	ns	62.31	9.900	0.004	9951	0.003	**	6.294
<b>Zn</b>	1E+07	0.150	0.769	454	0.704	ns	7E+07	<i>Pooled</i>					

**Table S4.1 Summary of PERMANOVA test on selected trace elements mean concentrations ( $\mu\text{g kg}^{-1}$  dry weight) in tunic of *P. aurata* at Totok Bay (TB) vs. Control and among sites nested in Impact  $\times$  Control. When less than 100 unique permutations were available, the asymptotic Monte Carlo p-value was used instead of the permutational one. When no significant differences in mean element concentrations were found among control sites ( $p > 0.25$ ), the site data was pooled to increase degrees of freedom for the main test denominator to 38. Significant levels were indicated by the following symbols: ns = not significant; \* =  $p < 0.05$ ; \*\* =  $p < 0.01$ ; \*\*\* =  $p < 0.001$ .**

	Totok Bay vs. Control					Sites (Totok Bay $\times$ Control)					Res		
	MS	$\frac{p}{F_{1,3}}$	$p$ (perm)	N. perm	$p$ (MC)	MS	$p$ F3,35	$p$ (perm)	N. perm	$p$ (MC)	MS		
<b>Hg</b>	0.526	132.9	0.000	9580	0.000	***	0.004	<i>Pooled</i>					
<b>Al</b>	2335	0.108	1.000	5	0.772	ns	21678	12.84	0.000	9955	0.000	***	1689
<b>As</b>	41.32	15.35	0.204	5	0.027	*	2.692	2.578	0.071	9950	0.072	ns	1.045
<b>Ba</b>	0.019	0.070	0.599	5	0.809	ns	0.265	19.20	0.000	9958	0.000	***	0.014
<b>Cr</b>	10.51	1.919	0.148	9851	0.172	ns	5.479	<i>Pooled</i>					
<b>Cu</b>	8.670	13.81	0.001	9816	0.001	**	0.628	<i>Pooled</i>					
<b>Fe</b>	2238	0.155	0.806	5	0.719	ns	14408	13.89	0.000	9950	0.000	***	1037
<b>Mn</b>	40.34	0.237	1.000	5	0.665	ns	170.4	38.06	0.000	9949	0.000	***	4.477
<b>Mo</b>	2.219	2.683	0.198	5	0.204	ns	0.827	4.320	0.009	9961	0.009	**	0.191
<b>Sb</b>	0.000	2.479	0.398	5	0.215	ns	1E-04	2.355	0.076	9950	0.089	ns	4E-05
<b>V</b>	0.025	0.219	0.650	9839	0.640	ns	0.113	<i>Pooled</i>					
<b>Zn</b>	14.309	0.388	0.608	5	0.576	ns	36.89	3.520	0.025	9961	0.026	*	10.48

**Table S4.2 Summary of PERMANOVA test on selected trace elements mean concentrations ( $\mu\text{g kg}^{-1}$  dry weight) in tunic of *P. aurata* at Talawaan River (TW) vs. Control and among sites nested in Impact  $\times$  Control. When less than 100 unique permutations were available, the asymptotic Monte Carlo p-value was used instead of the permutational one. When no significant differences in mean element concentrations were found among control sites ( $p > 0.25$ ), the site data was pooled to increase degrees of freedom for the main test denominator to 38. Significant levels were indicated by the following symbols: ns = not significant; \* =  $p < 0.05$ ; \*\* =  $p < 0.01$ ; \*\*\* =  $p < 0.001$ .**

	Talawaan River vs. Control						Sites (Talawaan River $\times$ Control)					Res MS	
	MS	p F1,3	p (perm)	N. perm	p (MC)		MS	p F3,35	p (perm)	N. perm	p (MC)		
<b>Hg</b>	1.254	188.4	0.000	9616	0.000	***	0.007	<i>Pooled</i>					
<b>Al</b>	7.928	0.000	1.000	5	0.986	ns	21678	11.57	0.000	9947	0.000	***	1873
<b>As</b>	12.75	4.734	0.194	5	0.119	ns	2.692	2.118	0.117	9948	0.113	ns	1.271
<b>Ba</b>	0.097	0.367	0.602	5	0.597	ns	0.265	19.65	0.000	9950	0.000	***	0.013
<b>Cr</b>	13.93	2.553	0.100	9854	0.120	ns	5.459	<i>Pooled</i>					
<b>Cu</b>	0.000	0.000	1.000	5	0.985	ns	0.747	2.407	0.085	9940	0.083	ns	0.310
<b>Fe</b>	557.6	0.039	0.796	5	0.856	ns	14408	13.34	0.000	9943	0.000	***	1080
<b>Mn</b>	23.22	0.136	1.000	5	0.734	ns	170.4	59.30	0.000	9950	0.000	***	2.873
<b>Mo</b>	6.191	7.485	0.200	5	0.076	ns	0.827	3.034	0.043	9951	0.042	*	0.273
<b>Sb</b>	5E-05	0.489	0.602	5	0.529	ns	1E-04	2.731	0.048	9947	0.056	ns	4E-05
<b>V</b>	2.366	18.27	0.000	9866	0.000	***	0.129	<i>Pooled</i>					
<b>Zn</b>	25.89	0.702	0.406	5	0.457	ns	36.89	3.315	0.028	9955	0.030	*	11.13

**Table S4.3 Summary of PERMANOVA test on selected trace elements mean concentrations ( $\mu\text{g kg}^{-1}$  dry weight) in tunic of *P. aurata* at Pantai Surabaya (PS) vs. Control and among sites nested in Impact  $\times$  Control. When less than 100 unique permutations were available, the asymptotic Monte Carlo p-value was used instead of the permutational one. When no significant differences in mean element concentrations were found among control sites ( $p > 0.25$ ), the site data was pooled to increase degrees of freedom for the main test denominator to 38. Significant levels were indicated by the following symbols: ns = not significant; \* =  $p < 0.05$ ; \*\* =  $p < 0.01$ ; \*\*\* =  $p < 0.001$ .**

	Pantai Surabaya vs. Control						Sites (Pantai Surabaya $\times$ Control)					Res MS	
	MS	p F1,3	p (perm)	N. perm	p (MC)		MS	p F3,35	p (perm)	N. perm	p (MC)		
<b>Hg</b>	0.002	1.877	0.180	8526	0.178	ns	0.001	<i>Pooled</i>					
<b>Al</b>	12039	0.555	0.801	5	0.507	ns	21678	9.464	0.001	9958	0.000	***	2291
<b>As</b>	1.890	0.702	0.600	5	0.471	ns	2.692	2.743	0.080	9947	0.079	ns	1.089
<b>Ba</b>	0.177	0.669	0.596	5	0.483	ns	0.265	22.09	0.000	9949	0.000	***	0.012
<b>Cr</b>	4.641	0.829	0.373	9859	0.376	ns	5.601	<i>Pooled</i>					
<b>Cu</b>	0.114	0.153	1.000	5	0.718	ns	0.747	2.733	0.057	9949	0.058	ns	0.273
<b>Fe</b>	2193	0.152	0.795	5	0.724	ns	14408	10.45	0.000	9952	0.000	***	1379
<b>Mn</b>	9.012	0.053	1.000	5	0.830	ns	170.4	54.08	0.000	9949	0.000	***	3.151
<b>Mo</b>	0.088	0.107	1.000	5	0.765	ns	0.827	5.419	0.003	9956	0.004	**	0.153
<b>Sb</b>	1E-06	0.013	1.000	5	0.920	ns	1E-04	2.870	0.035	9948	0.051	ns	3E-05
<b>V</b>	4.130	11.42	0.003	9832	0.002	**	0.362	<i>Pooled</i>					
<b>Zn</b>	23.39	0.634	0.599	5	0.487	ns	36.89	3.667	0.020	9950	0.021	*	10.06

**Table S4.4 Summary of PERMANOVA test on selected trace elements mean concentrations ( $\mu\text{g kg}^{-1}$  dry weight) in tunic of *P. aurata* at Coral Eye (CE) vs. Control and among sites nested in Impact  $\times$  Control. When less than 100 unique permutations were available, the asymptotic Monte Carlo p-value was used instead of the permutational one. When no significant differences in mean element concentrations were found among control sites ( $p > 0.25$ ), the site data was pooled to increase degrees of freedom for the main test denominator to 38. Significant levels were indicated by the following symbols: ns = not significant; \* =  $p < 0.05$ ; \*\* =  $p < 0.01$ ; \*\*\* =  $p < 0.001$ .**

	Coral Eye vs. Control						Sites (Coral Eye $\times$ Control)					Res MS	
	MS	p F1,3	p (perm)	N. perm	p (MC)		MS	p F3,35	p (perm)	N. perm	p (MC)		
<b>Hg</b>	0.000	0.062	0.802	8732	0.804	ns	0.002	<i>Pooled</i>					
<b>Al</b>	15570	0.718	0.401	<u>5</u>	0.460	ns	21678	14.29	0.000	9938	0.000	***	1517
<b>As</b>	9.461	3.514	0.189	5	0.160	ns	2.692	2.571	0.069	9958	0.068	ns	1.047
<b>Ba</b>	6E-05	0.000	1.000	5	0.991	ns	0.265	19.66	0.000	9960	0.000	***	0.013
<b>Cr</b>	22.39	4.135	0.047	9850	0.049	*	5.416	<i>Pooled</i>					
<b>Cu</b>	1.601	2.142	0.202	5	0.241	ns	0.747	1.587	0.201	9951	0.216	ns	0.471
<b>Fe</b>	19498	1.353	0.394	5	0.327	ns	14408	17.95	0.000	9958	0.000	***	803
<b>Mn</b>	35.86	0.210	0.802	5	0.671	ns	170.4	60.15	0.000	9953	0.000	***	2.833
<b>Mo</b>	0.407	0.492	0.794	5	0.536	ns	0.827	3.583	0.023	9954	0.026	*	0.231
<b>Sb</b>	0.000	0.016	1.000	5	0.903	ns	0.000	2.836	0.034	9960	0.057	ns	0.000
<b>V</b>	0.306	3.223	0.078	9839	0.077	ns	0.095	<i>Pooled</i>					
<b>Zn</b>	0.758	0.021	1.000	5	0.900	ns	36.89	3.609	0.022	9959	0.022	*	10.22

**Table S5.1 Summary of PERMANOVA test on selected trace elements mean concentrations ( $\mu\text{g kg}^{-1}$  dry weight) in body without tunic of *P. aurata* at Totok Bay (TB) vs. Control and among sites nested in Impact  $\times$  Control. When less than 100 unique permutations were available, the asymptotic Monte Carlo p-value was used instead of the permutational one. When no significant differences in mean element concentrations were found among control sites ( $p > 0.25$ ), the site data was pooled to increase degrees of freedom for the main test denominator to 38. Significant levels were indicated by the following symbols: ns = not significant; \* =  $p < 0.05$ ; \*\* =  $p < 0.01$ ; \*\*\* =  $p < 0.001$ .**

	Totok Bay vs. Control						Sites (Totok Bay $\times$ Control)					Res	
	MS	p F1,3	p (perm)	N. perm	p (MC)		MS	p F3,35	p (perm)	N. perm	p (MC)		MS
<b>Hg</b>	56.24	70.14	0.000	9839	0.000	***	0.802	<i>Pooled</i>					
<b>Al</b>	4E+05	0.167	0.800	5	0.706	ns	2E+06	17.67	0.000	9955	0.000	***	1E+05
<b>As</b>	222.4	1.180	0.401	5	0.356	ns	188.5	23.95	0.000	9965	0.000	***	7.868
<b>Ba</b>	0.018	0.011	1.000	5	0.923	ns	1.613	4.620	0.009	9936	0.009	**	0.349
<b>Cr</b>	3.941	7.318	0.011	9851	0.012	**	0.539	<i>Pooled</i>					
<b>Cu</b>	256.5	42.39	0.000	9823	0.000	***	6.051	<i>Pooled</i>					
<b>Fe</b>	1E+05	0.082	0.807	5	0.797	ns	1E+06	14.84	0.000	9941	0.000	***	87755
<b>Mn</b>	1.543	0.003	1.000	5	0.958	ns	459.1	20.81	0.000	9963	0.000	***	22.07
<b>Mo</b>	2E+08	23.98	0.000	9826	0.000	***	7E+06	<i>Pooled</i>					
<b>Sb</b>	0.003	3.536	0.202	5	0.157	ns	0.001	3.603	0.023		0.023	*	0.000
<b>V</b>	1.752	0.193	0.796	5	0.694	ns	9.102	8.430	0.000	9953	0.000	***	1.080
<b>Zn</b>	135.8	0.168	1.000	5	0.713	ns	809.2	2.109	0.112	9948	0.118	ns	383.6

**Table S5.2 Summary of PERMANOVA test on selected trace elements mean concentrations ( $\mu\text{g kg}^{-1}$  dry weight) in body without tunic of *P. aurata* at Talawaan River (TW) vs. Control and among sites nested in Impact  $\times$  Control. When less than 100 unique permutations were available, the asymptotic Monte Carlo p-value was used instead of the permutational one. When no significant differences in mean element concentrations were found among control sites ( $p > 0.25$ ), the site data was pooled to increase degrees of freedom for the main test denominator to 38. Significant levels were indicated by the following symbols: ns = not significant; \* =  $p < 0.05$ ; \*\* =  $p < 0.01$ ; \*\*\* =  $p < 0.001$ .**

	Talawaan River vs. Control						Sites (Talawaan River $\times$ Control)					Res	
	MS	p F1,3	p (perm)	N. perm	p (MC)		MS	p F3,35	p (perm)	N. perm	p (MC)	MS	
<b>Hg</b>	9.896	41.070	0.000	9855	0.000	***	0.241	<i>Pooled</i>					
<b>Al</b>	4E+05	0.154	0.799	5	0.723	ns	2E+06	17.04	0.000	9966	0.00	***	1E+05
<b>As</b>	107.8	0.572	0.598	5	0.500	ns	188.5	23.23	0.000	9939	0.00	***	8.112
<b>Ba</b>	0.927	0.575	0.600	5	0.510	ns	1.613	4.849	0.006	9946	0.01	**	0.333
<b>Cr</b>	1.292	2.964	0.088	9851	0.097	ns	0.436	<i>Pooled</i>					
<b>Cu</b>	6.655	0.929	0.599	5	0.414	ns	7.165	2.740	0.059	9954	0.06	ns	2.615
<b>Fe</b>	2E+05	0.156	0.807	5	0.714	ns	1E+06	14.36	0.000	9957	0.00	***	90687
<b>Mn</b>	17.298	0.038	1.000	5	0.862	ns	459.1	21.77	0.000	9954	0.00	***	21.09
<b>Mo</b>	6E+05	0.064	1.000	5	0.811	ns	9E+06	2.225	0.102	9960	0.10	ns	4E+06
<b>Sb</b>	0.002	2.633	0.201	5	0.202	ns	0.001	3.253	0.034	9962	0.03	*	0.000
<b>V</b>	0.431	0.047	0.809	5	0.842	ns	9.102	8.090	0.001	9958	0.00	***	1.125
<b>Zn</b>	2798	3.808	0.050	9841	0.056	ns	734.8	<i>Pooled</i>					

**Table S5.3 Summary of PERMANOVA test on selected trace elements mean concentrations ( $\mu\text{g kg}^{-1}$  dry weight) in body without tunic of *P. aurata* at Pantai Surabaya (PS) vs. Control and among sites nested in Impact  $\times$  Control. When less than 100 unique permutations were available, the asymptotic Monte Carlo p-value was used instead of the permutational one. When no significant differences in mean element concentrations were found among control sites ( $p > 0.25$ ), the site data was pooled to increase degrees of freedom for the main test denominator to 38. Significant levels were indicated by the following symbols: ns = not significant; \* =  $p < 0.05$ ; \*\* =  $p < 0.01$ ; \*\*\* =  $p < 0.001$ .**

	Pantai Surabaya vs. Control						Sites (Pantai Surabaya $\times$ Control)						Res MS
	MS	p F1,3	p (perm)	N. perm	p (MC)		MS	p F3,35	p (perm)	N. perm	p (MC)		
<b>Hg</b>	0.140	1.937	0.160	9848	0.175	ns	0.072	<i>Pooled</i>					
<b>Al</b>	9E+05	0.354	0.804	5	0.589	ns	2E+06	17.66	0.000	9949	0.00	***	1E+05
<b>As</b>	10.30	0.055	0.796	5	0.830	ns	188.5	22.19	0.000	9957	0.00	***	8.491
<b>Ba</b>	1.322	0.819	0.590	5	0.436	ns	1.613	4.880	0.005	9943	0.01	*	0.331
<b>Cr</b>	2.118	9.749	0.006	9837	0.004	**	0.217	<i>Pooled</i>					
<b>Cu</b>	3.462	0.483	0.603	5	0.540	ns	7.165	2.668	0.061	9947	0.06	ns	2.686
<b>Fe</b>	5E+05	0.376	0.795	5	0.587	ns	1E+06	14.87	0.000	9946	0.00	***	87563
<b>Mn</b>	0.233	0.001	1.000	5	0.985	ns	459.1	21.98	0.000	9962	0.00	***	20.89
<b>Mo</b>	3E+07	3.129	0.201	5	0.176	ns	9E+06	2.583	0.072	9967	0.07	ns	3E+06
<b>Sb</b>	0.001	1.072	0.595	5	0.375	ns	0.001	3.696	0.018	9958	0.02	*	0.000
<b>V</b>	6.719	0.738	0.396	5	0.461	ns	9.102	8.514	0.001	9956	0.00	***	1.069
<b>Zn</b>	478.7	0.592	0.794	5	0.504	ns	809.2	2.305	0.081	9955	0.10	ns	351.0

**Table S5.4 Summary of PERMANOVA test on selected trace elements mean concentrations ( $\mu\text{g kg}^{-1}$  dry weight) in body without tunic of *P. aurata* at Coral Eye (CE) vs. Control and among sites nested in Impact  $\times$  Control. When less than 100 unique permutations were available, the asymptotic Monte Carlo p-value was used instead of the permutational one. When no significant differences in mean element concentrations were found among control sites ( $p > 0.25$ ), the site data was pooled to increase degrees of freedom for the main test denominator to 38. Significant levels were indicated by the following symbols: ns = not significant; \* =  $p < 0.05$ ; \*\* =  $p < 0.01$ ; \*\*\* =  $p < 0.001$ .**

	Coral Eye vs. Control						Sites (Coral Eye $\times$ Control)					Res	
	MS	p F1,3	p (perm)	N. perm	p (MC)		MS	p F3,35	p (perm)	N. perm	p (MC)		MS
<b>Hg</b>	0.207	2.812	0.096	9854	0.099	ns	0.074	<i>Pooled</i>					
<b>Al</b>	9E+05	0.352	0.804	5	0.592	ns	2E+06	17.69	0.000	9955	0.00	***	1E+05
<b>As</b>	101.8	0.540	0.602	5	0.512	ns	188.5	23.72	0.000	9952	0.00	***	7.945
<b>Ba</b>	0.127	0.079	1.000	5	0.795	ns	1.613	3.970	0.013	9950	0.01	*	0.406
<b>Cr</b>	0.019	0.060	0.818	9874	0.806	ns	0.320	<i>Pooled</i>					
<b>Cu</b>	1.029	0.144	0.602	5	0.733	ns	7.165	2.958	0.044	9962	0.05	*	2.422
<b>Fe</b>	5E+05	0.377	0.802	5	0.580	ns	1E+06	14.91	0.000	9955	0.00	***	87365
<b>Mn</b>	133.64	0.291	0.605	5	0.627	ns	459.1	22.41	0.000	9960	0.00	***	20.49
<b>Mo</b>	2E+07	1.852	0.402	5	0.263	ns	9E+06	2.636	0.064	9954	0.07	ns	3E+06
<b>Sb</b>	2E-05	0.028	1.000	5	0.880	ns	0.001	3.450	0.024	9959	0.03	*	0.000
<b>V</b>	5.177	0.569	0.403	5	0.512	ns	9.102	8.515	0.000	9959	0.00	***	1.069
<b>Zn</b>	1309	1.617	0.398	5	0.292	ns	809.2	2.411	0.076	9958	0.09	ns	335.6

**Table S6. Biota-SPM accumulation factors (BAFs) for each element in tunic (TUN) and body without tunic (BWT) at each site: Totok Bay (TB); Talawaan River (TW); Pantai Surabaya (PS); Coral Eye (CE); Batu Belah (BB); Batu Nona (BN); Talisei Island (TA); Tasik Ria Resort (TR). Mean among sites and p-values, under the null hypothesis that the mean is not greater than 1, are reported (significant values in bold).**

Tissue	Site	Hg	Al	As	Ba	Cr	Cu	Fe	Mn	Mo	Sb	V	Zn
TUN	TB	2.62	0.0009	0.29	2.30E-05	0.08	0.19	0.01	0.04	1.24	0.03	0.08	1.34E-04
	TW	5.10	0.0010	0.34	9.93E-06	0.07	0.11	0.00	0.00	1.50	0.03	0.05	1.04E-04
	PS	21.85	0.0021	0.47	3.02E-05	0.11	0.08	0.01	0.00	0.81	0.03	0.07	1.33E-04
	CE	18.70	0.0003	0.56	2.51E-05	0.05	0.21	0.01	0.01	0.70	0.04	0.12	1.69E-04
	BB	14.88	0.0006	0.51	2.57E-05	0.23	0.21	0.02	0.02	0.20	0.03	0.17	1.62E-04
	BN	17.45	0.0030	0.73	3.00E-05	0.11	0.14	0.02	0.07	0.70	0.03	0.08	2.33E-04
	TA	19.45	0.0005	0.62	1.99E-05	0.19	0.12	0.01	0.01	0.99	0.03	0.12	1.73E-04
	TR	19.67	0.0015	0.53	1.53E-05	0.10	0.13	0.01	0.00	0.54	0.02	0.07	1.17E-04
Mean		<b>14.97</b>	0.0012	0.51	2.24E-05	0.12	0.15	0.01	0.02	0.84	0.03	0.10	1.53E-04
p-value		<b>&lt;0.001</b>	1	1	1	1	1	1	1	0.86	1	1	1
Tissue	Site	Hg	Al	As	Ba	Cr	Cu	Fe	Mn	Mo	Sb	V	Zn
BWT	TB	23.59	0.0028	0.60	3.43E-05	0.08	0.60	0.03	0.04	6.07	0.07	0.08	8.64E-04
	TW	15.77	0.0023	0.67	9.64E-06	0.07	0.28	0.01	0.01	3.08	0.07	0.04	9.91E-04
	PS	50.32	0.0004	1.29	2.68E-05	0.01	0.22	0.00	0.01	1.59	0.05	0.03	6.38E-04
	CE	43.61	0.0005	1.05	4.27E-05	0.05	0.38	0.01	0.03	1.26	0.07	0.12	4.94E-04
	BB	62.66	0.0002	1.79	4.89E-05	0.05	0.52	0.01	0.06	0.78	0.07	0.14	1.17E-03
	BN	75.03	0.0266	1.35	4.96E-05	0.05	0.27	0.15	0.12	2.51	0.04	0.22	6.21E-04
	TA	88.75	0.0004	0.97	1.97E-05	0.04	0.26	0.01	0.01	2.96	0.07	0.12	6.27E-04
	TR	99.43	0.0067	0.95	1.43E-05	0.03	0.33	0.05	0.01	1.61	0.04	0.10	8.42E-04
Mean		<b>57.39</b>	0.0050	1.08	3.07E-05	0.05	0.36	0.03	0.04	<b>2.48</b>	0.06	0.11	7.81E-04
p-value		<b>&lt;0.001</b>	1	0.28	1	1	1	1	1	<b>0.02</b>	1	1	1

**Table S7. Mercury, chromium and copper concentrations (mean  $\pm$  standard deviation, expressed in  $\mu\text{g g}^{-1}$  dry weight) in different tissues of the solitary ascidians *Phallusia nigra*, *Styela plicata*, *Microcosmus exasperatus*, *Halocynthia aurantium*, and *Polycarpa aurata* from different sites.**

Ascidian	Tissue	Hg	Cr	Cu	Study site	Site description	Ref.
<i>Phallusia nigra</i>	Tunic	0.016960 $\pm$ 0.00204		0.49 $\pm$ 0.04	Thoothukudi Port, India	industrial discharge and commercial port operation	[1]
<i>Phallusia nigra</i>	Tunic	0.018814 $\pm$ 0.00226		0.29 $\pm$ 0.02	Vizhinjam Port, India	commercial port operation	[1]
<i>Phallusia nigra</i>	Mantle	0.021460 $\pm$ 0.00258		4.26 $\pm$ 0.34	Thoothukudi Port, India	industrial discharge and commercial port operation	[1]
<i>Phallusia nigra</i>	Mantle	0.028262 $\pm$ 0.00339		1.78 $\pm$ 0.14	Vizhinjam Port, India	commercial port operation	[1]
<i>Phallusia nigra</i>	Whole body			38.80 $\pm$ 19.52	Akko, Israel, Mediterranean Sea	industrial discharge	[2]
<i>Phallusia nigra</i>	Whole body			13.39 $\pm$ 7.61	Mikhmoret, Israel, Mediterranean Sea	limited human activities	[2]
<i>Phallusia nigra</i>	Whole body			41.15 $\pm$ 22.47	Eilat, Israel, Red Sea	moderate anthropic activity	[2]
<i>Phallusia nigra</i>	Tunic			23.03 $\pm$ 25.57	Akko, Israel, Mediterranean Sea	industrial discharge	[2]
<i>Phallusia nigra</i>	Tunic			6.34 $\pm$ 4.77	Mikhmoret, Israel, Mediterranean Sea	limited human activities	[2]
<i>Phallusia nigra</i>	Tunic			15.59 $\pm$ 9.54	Eilat, Israel, Red Sea	moderate anthropic activity	[2]
<i>Phallusia nigra</i>	Tunic	0.02623 $\pm$ 0.01594			P1, Todos os Santos Bay, Brazil	industrial discharge and anthropic activity	[3]
<i>Phallusia nigra</i>	Tunic	0.02227 $\pm$ 0.01247			P2, Todos os Santos Bay, Brazil	industrial discharge and anthropic activity	[3]
<i>Phallusia nigra</i>	Tunic	0.02770 $\pm$ 0.01219			P3, Todos os Santos Bay, Brazil	industrial discharge and anthropic activity	[3]
<i>Phallusia nigra</i>	Tunic	0.03023 $\pm$ 0.00188			P4, Todos os Santos Bay, Brazil	industrial discharge and anthropic activity	[3]
<i>Phallusia nigra</i>	Tunic	0.02643 $\pm$ 0.00073			P5, Todos os Santos Bay, Brazil	industrial discharge and anthropic activity	[3]
<i>Phallusia nigra</i>	Tunic	0.02333 $\pm$ 0.00582			P6, Todos os Santos Bay, Brazil	industrial discharge and anthropic activity	[3]
<i>Phallusia nigra</i>	Tunic	0.03327 $\pm$ 0.01215			P7, Todos os Santos Bay, Brazil	industrial discharge and anthropic activity	[3]
<i>Phallusia nigra</i>	Tunic	0.02163 $\pm$ 0.00262			P8, Todos os Santos Bay, Brazil	industrial discharge and anthropic activity	[3]
<i>Phallusia nigra</i>	Hepatopancreas	0.09200 $\pm$ 0.01006			P1, Todos os Santos Bay, Brazil	industrial discharge and anthropic activity	[3]
<i>Phallusia nigra</i>	Hepatopancreas	0.08233 $\pm$ 0.01668			P2, Todos os Santos Bay, Brazil	industrial discharge and anthropic activity	[3]
<i>Phallusia nigra</i>	Hepatopancreas	0.08100 $\pm$ 0.01114			P3, Todos os Santos Bay, Brazil	industrial discharge and anthropic activity	[3]
<i>Phallusia nigra</i>	Hepatopancreas	0.06967 $\pm$ 0.01437			P4, Todos os Santos Bay, Brazil	industrial discharge and anthropic activity	[3]
<i>Phallusia nigra</i>	Hepatopancreas	0.07100 $\pm$ 0.02209			P5, Todos os Santos Bay, Brazil	industrial discharge and anthropic activity	[3]
<i>Phallusia nigra</i>	Hepatopancreas	0.09033 $\pm$ 0.01941			P6, Todos os Santos Bay, Brazil	industrial discharge and anthropic activity	[3]
<i>Phallusia nigra</i>	Hepatopancreas	0.13070 $\pm$ 0.01210			P7, Todos os Santos Bay, Brazil	industrial discharge and anthropic activity	[3]
<i>Phallusia nigra</i>	Hepatopancreas	0.07367 $\pm$ 0.00364			P8, Todos os Santos Bay, Brazil	industrial discharge and anthropic activity	[3]
<i>Phallusia nigra</i>	Branchial basket	0.12890 $\pm$ 0.02210			P1, Todos os Santos Bay, Brazil	industrial discharge and anthropic activity	[3]
<i>Phallusia nigra</i>	Branchial basket	0.08200 $\pm$ 0.01999			P2, Todos os Santos Bay, Brazil	industrial discharge and anthropic activity	[3]
<i>Phallusia nigra</i>	Branchial basket	0.08900 $\pm$ 0.04116			P3, Todos os Santos Bay, Brazil	industrial discharge and anthropic activity	[3]
<i>Phallusia nigra</i>	Branchial basket	0.14170 $\pm$ 0.01246			P4, Todos os Santos Bay, Brazil	industrial discharge and anthropic activity	[3]
<i>Phallusia nigra</i>	Branchial basket	0.11950 $\pm$ 0.01078			P5, Todos os Santos Bay, Brazil	industrial discharge and anthropic activity	[3]
<i>Phallusia nigra</i>	Branchial basket	0.12900 $\pm$ 0.00784			P6, Todos os Santos Bay, Brazil	industrial discharge and anthropic activity	[3]
<i>Phallusia nigra</i>	Branchial basket	0.31270 $\pm$ 0.05427			P7, Todos os Santos Bay, Brazil	industrial discharge and anthropic activity	[3]
<i>Phallusia nigra</i>	Branchial basket	0.19270 $\pm$ 0.00510			P8, Todos os Santos Bay, Brazil	industrial discharge and anthropic activity	[3]
<i>Styela plicata</i>	Branchial basket	0.003 $\pm$ 0.001	0.078 $\pm$ 0.06	1.22 $\pm$ 0.92	Termini Imerese Harbor, Italy	industrial discharge and commercial port operation	[4]
<i>Styela plicata</i>	Hepatopancreas	< detection limit	0.028 $\pm$ 0.03	1.072 $\pm$ 0.66	Termini Imerese Harbor, Italy	industrial discharge and commercial port operation	[4]
<i>Styela plicata</i>	Tunic		0.092 $\pm$ 0.04	0.972 $\pm$ 0.43	Termini Imerese Harbor, Italy	industrial discharge and commercial port operation	[4]
<i>Microcosmus exasperatus</i>	Whole body			12.31 $\pm$ 5.96	Akko, Israel, Mediterranean Sea	industrial discharge	[2]
<i>Microcosmus exasperatus</i>	Whole body			8.78 $\pm$ 5.51	Mikhmoret, Israel, Mediterranean Sea	limited human activities	[2]
<i>Microcosmus exasperatus</i>	Tunic			17.08 $\pm$ 5.43	Akko, Israel, Mediterranean Sea	industrial discharge	[2]
<i>Microcosmus exasperatus</i>	Tunic			10.90 $\pm$ 8.03	Mikhmoret, Israel, Mediterranean Sea	limited human activities	[2]
<i>Halocynthia aurantium</i> (2)	Muscle			2.21 $\pm$ 0.30	Reineke Island, Russia, Sea of Japan	limited human activities	[5]
<i>Halocynthia aurantium</i> (2)	Tunic			2.73 $\pm$ 0.33	Reineke Island, Russia, Sea of Japan	limited human activities	[5]

Ascidian	Tissue	Hg	Cr	Cu	Study site	Site description	Ref.
<i>Halocynthia aurantium</i> (3)	Muscle			2.95 ± 0.27	Reineke Island, Russia, Sea of Japan	limited human activities	[5]
<i>Halocynthia aurantium</i> (3)	Tunic			3.14 ± 0.34	Reineke Island, Russia, Sea of Japan	limited human activities	[5]
<i>Halocynthia aurantium</i> (2)	Gonads			8.91 ± 0.30	Postovaya Bay, Russia, Sea of Japan	commercial port operation and anthropic activity	[5]
<i>Halocynthia aurantium</i> (2)	Tunic			1.82 ± 0.02	Postovaya Bay, Russia, Sea of Japan	commercial port operation and anthropic activity	[5]
<i>Halocynthia aurantium</i> (2)	Digestive gland			2.70 ± 0.05	Postovaya Bay, Russia, Sea of Japan	commercial port operation and anthropic activity	[5]
<i>Halocynthia aurantium</i> (2)	Mantle			1.92 ± 0.01	Postovaya Bay, Russia, Sea of Japan	commercial port operation and anthropic activity	[5]
<i>Halocynthia aurantium</i> (2)	Stomach			25.70 ± 1.30	Postovaya Bay, Russia, Sea of Japan	commercial port operation and anthropic activity	[5]
<i>Halocynthia aurantium</i> (3)	Gonads			8.20 ± 0.40	Postovaya Bay, Russia, Sea of Japan	commercial port operation and anthropic activity	[5]
<i>Halocynthia aurantium</i> (3)	Tunic			1.95 ± 0.07	Postovaya Bay, Russia, Sea of Japan	commercial port operation and anthropic activity	[5]
<i>Halocynthia aurantium</i> (3)	Digestive gland			5.50 ± 0.10	Postovaya Bay, Russia, Sea of Japan	commercial port operation and anthropic activity	[5]
<i>Halocynthia aurantium</i> (3)	Mantle			1.72 ± 0.03	Postovaya Bay, Russia, Sea of Japan	commercial port operation and anthropic activity	[5]
<i>Halocynthia aurantium</i> (3)	Stomach			17.61 ± 0.80	Postovaya Bay, Russia, Sea of Japan	commercial port operation and anthropic activity	[5]
<i>Halocynthia aurantium</i>	Gonads			4.30 ± 0.02	Kievka Bay, Russia, Sea of Japan	limited human activities	[5]
<i>Halocynthia aurantium</i>	Tunic			2.75 ± 0.20	Kievka Bay, Russia, Sea of Japan	limited human activities	[5]
<i>Halocynthia aurantium</i>	Digestive gland			7.11 ± 0.20	Kievka Bay, Russia, Sea of Japan	limited human activities	[5]
<i>Halocynthia aurantium</i>	Mantle			1.41 ± 0.01	Kievka Bay, Russia, Sea of Japan	limited human activities	[5]
<i>Halocynthia aurantium</i>	Stomach			4.23 ± 0.20	Kievka Bay, Russia, Sea of Japan	limited human activities	[5]
<i>Polycarpa aurata</i>	Tunic	0.37 ± 0.13	1.51 ± 0.61	3.96 ± 1.37	Totok Bay, North Sulawesi, Indonesia	artisanal gold mine	PS
<i>Polycarpa aurata</i>	Tunic	0.53 ± 0.17	1.32 ± 0.61	2.80 ± 0.57	Talawaan River, North Sulawesi, Indonesia	artisanal gold mine	PS
<i>Polycarpa aurata</i>	Tunic	0.10 ± 0.03	1.94 ± 1.02	2.66 ± 0.38	Pantai Surabaya, North Sulawesi, Indonesia	industrial gold mine	PS
<i>Polycarpa aurata</i>	Tunic	0.09 ± 0.06	0.92 ± 0.17	3.30 ± 1.06	Coral Eye, North Sulawesi, Indonesia	mine site in preparation	PS
<i>Polycarpa aurata</i>	Tunic	0.07 ± 0.03	3.67 ± 2.24	3.06 ± 0.75	Batu Belah, North Sulawesi, Indonesia	limited human activities	PS
<i>Polycarpa aurata</i>	Tunic	0.08 ± 0.05	2.31 ± 1.24	3.06 ± 0.45	Batu Nona, North Sulawesi, Indonesia	limited human activities	PS
<i>Polycarpa aurata</i>	Tunic	0.09 ± 0.03	3.31 ± 4.47	2.52 ± 0.52	Talisei Island, North Sulawesi, Indonesia	limited human activities	PS
<i>Polycarpa aurata</i>	Tunic	0.09 ± 0.03	1.88 ± 0.69	2.55 ± 0.42	Tasik Ria Resort, North Sulawesi, Indonesia	limited human activities	PS
<i>Polycarpa aurata</i>	Body without tunic	3.35 ± 2.00	1.60 ± 1.32	12.63 ± 4.30	Totok Bay, North Sulawesi, Indonesia	artisanal gold mine	PS
<i>Polycarpa aurata</i>	Body without tunic	1.63 ± 0.97	1.27 ± 1.09	7.32 ± 1.34	Talawaan River, North Sulawesi, Indonesia	artisanal gold mine	PS
<i>Polycarpa aurata</i>	Body without tunic	0.24 ± 0.15	0.24 ± 0.10	7.04 ± 1.46	Pantai Surabaya, North Sulawesi, Indonesia	industrial gold mine	PS
<i>Polycarpa aurata</i>	Body without tunic	0.21 ± 0.17	0.87 ± 0.75	5.90 ± 0.91	Coral Eye, North Sulawesi, Indonesia	mine site in preparation	PS
<i>Polycarpa aurata</i>	Body without tunic	0.30 ± 0.12	0.86 ± 0.46	7.63 ± 1.85	Batu Belah, North Sulawesi, Indonesia	limited human activities	PS
<i>Polycarpa aurata</i>	Body without tunic	0.36 ± 0.26	0.98 ± 0.56	5.92 ± 2.00	Batu Nona, North Sulawesi, Indonesia	limited human activities	PS
<i>Polycarpa aurata</i>	Body without tunic	0.42 ± 0.43	0.77 ± 0.66	5.43 ± 1.30	Talisei Island, North Sulawesi, Indonesia	limited human activities	PS
<i>Polycarpa aurata</i>	Body without tunic	0.47 ± 0.28	0.66 ± 0.38	6.24 ± 1.47	Tasik Ria Resort, North Sulawesi, Indonesia	limited human activities	PS

(2): 2-yrs ind.; (3): 3-yrs ind. PS: present study

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