

Appendix I. Studies of heavy metal concentrations and their corresponding analytical quality control procedures*

References	Test materials	Test elements	Intra-laboratory quality control procedures			External control (ISO/IEC 17025 certification)
			Certified reference material, percentage of recovery**	Coefficient of variation	Other ***	
Undergraduate theses						
Alcívar-Tenorio and Mosquera-Armijo (2011)	Water, sediment	Cr, Cd, Pb	NA	NA	BS, CC, R	x
Castro-Infante (2015)	<i>Crassostrea columbiensis</i> (soft tissues)	Cd, Hg, Pb,	NA	Min.: 40 % Cd Max.: 160 % Hg	NA	NA
Chuquimarca-Montesdeoca (2015)	<i>Ucides occidentalis</i> (clam and hepatopancreas)	Cd, Hg, Pb,	NA	Min.: 79 % Pb Max.: 176 % Hg	CC, LOD	NA
Del Pezo-Quijije and Ruiz-Chiriguaya (2016)	Water	Cd, Hg, Pb,	NA	NA	NA	NA
Feys-Espinoza (2013)	<i>Ucides occidentalis</i> (Exoskeleton)	Cd, Pb	NA	NA	BS, CC, LOD, R	x
Franco-Solórzano (2015)	<i>Callinectes arcuatus</i> (soft tissue and hepatopancreas)	Cr, Ni, Cd, Hg, Pb	NA	NA	BS, CC	NA
Jiménez-Verdesoto (2012)	<i>Crassostrea columbiensis</i> (visceral mass), water, sediment	Cr, Ni, Cd, Pb	NA	NA	BS, CC, LOD, R	x
Ordóñez-Lucin (2015)	<i>Anadara tuberculosa</i>	Cd, Hg, Pb	NA	Min: 40 % Hg Max.: 97 % Hg	CC, LOD	NA
Ortega-Pereira (2015)	<i>Diapterus peruvians</i> , <i>Sardinops sagax</i>	Mn, Ni, Cu, Zn Cd, Hg, Pb	Fish IAEA-407, from 74% (Cd) to 100% (Pb)	Min.: < 1 % Mn Max.: 3 % Pb	CV, R	NA
Banguera-Rodríguez (2013)	Water, sediment, <i>Mytella guyanensis</i> (soft tissues)	Ni, Cd, Pb	“Sediment”, NA	NA	BS, CC, LOD, R	x
Siavichay-Lalangui (2013)	Sediment, <i>Ucides occidentalis</i> (soft tissue and digestive gland)	Cd, Pb	NA	NA	BS, CC, LOD, R	NA
Tobar-Ordóñez (2013)	<i>Anadara tuberculosa</i> , <i>Anadara similis</i>	Cr, Mn, Co, Ni, Cu, Zn As, Cd, Hg, Pb,	Fish IAEA-407, from 74% Cd to 103% Co	Min.: < 1 % Zn Max.: 57 % Hg	CV, R	NA
Master theses						
Carpio-Rivera (2016)	Water, sediments	Cd, Pb	Water and sediment FAPAS and FEPAS type (NA)	Min.: 7 % Pb Max.: 107 % Cd	NA	NA

*References on analytical quality assurance procedures. Studies assessed heavy metal concentrations in water, sediments and seafood from the Gulf of Guayaquil. Definitions follow Taverniers et al. (2004). Methods used to quantify the concentration of test elements present in test materials were: AAS: atomic absorption spectrometry, CVAA: cold vapor AAS, FAAS: flame AAS, GH-AAS: hydride generation AAS
 **Material of known purity used alongside with the samples to validate the analytical method. Once analyzed, a percentage of recovery is calculated to represent the efficiency of the method in extracting the test element from the test material. NA = Not available
 ***Other method performance parameters: BS: blank samples, CC: calibration curve, LOD: limit of detection, LOL: limit of linearity, LOQ: limit of quantification, R: replicates

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Carrasco-Peña and Webster-Coello (2016)	<i>Anadara tuberculo- sa, Mytella guya- nensis, Leukoma asperima</i>	Cr, Cu, As, Cd, Hg, Pb	NA	NA	CC, LOD, LOQ	NA
Jiménez-Verdesoto (2012)	Sediments	Cd, Pb	NA	Min.: 17 % Pb Max.: 84 % Cd	NA	NA
Kuffö-García (2013)	<i>Mytella strigata</i>	Cr, Cd, Pb	NA	NA	CC, LOL	NA
Mero-Valarezo (2010)	<i>Mytella strigata, Ostrea columbiensis</i>	Cd, Pb	“Sediment”, NA	NA	CC, LOD	x
Proaño-Alvarado (2016)	Water, sediments	Cd, Cr, Pb	Sediment CRM 008, NA	Min.: 11 % Cr Max.: 122 % Cr	CC	NA
Rivera-Pizarro (2016)	Water, sediments	As, Cd, Hg, Pb	NA	NA	NA	x
Doctoral theses						
Huayamave (2013)	Water	Cr, Ni, Cu, Zn, Cd, Hg, Pb	NA	NA	NA	NA
Peer-reviewed articles						
Ayala-Armijos et al. (2015)	<i>Ucides occidentalis</i> (soft tissue)	Cr, As, Hg, Pb	NA	Min.: 3 % As Max.: 4 % Pb	CC	NA
Fernández-Cadena et al. (2014)	Sediment	Li, Be, Al, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Mo, Ag, Cd, Sn, Pb	Marine sediment MESS-3, from 49 % Sn to 119 % Cd	NA	NA	NA
Ramírez-Prado et al. (2016), Ramírez-Prado (2016)	<i>Pomacea canalicu- lata</i>	Cd	Sediment, NA	NA	BS, CC, LOD, LOL	NA

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Appendix II. Concentration ranges in organic and inorganic materials for trace elements not regulated by the European Commission (2016)*

Material (common names in Spanish/English)	Concentration (ppm)							References
	Chromium (Cr)	Zinc (Zn)	Arsenic (As)	Copper (Cu)	Nickel (Ni)	Cobalt (Co)	Manganese (Mn)	
Organic								
Mollusca								
<i>Crassostrea columbien- sis</i> (osti3n de mangle/ Columbia black oyster)	0.13 – 0.29	—	—	—	0.40 – 1.16	—	—	Jim3nez- Verdesoto (2012)
<i>Mytella guyanensis</i> (mejill3n/Guyana swamp mussel)	—	—	—	—	1.71	—	—	Banguera-Ro- dr3guez (2013)
<i>Mytella guyanensis</i> (mejill3n/Guyana swamp mussel)	0.44-0.76	—	—	21.05-31.78	—	—	—	Carrasco-Pe3a and Webster- Coello (2016)
<i>Anadara tuberculosa</i> (concha prieta/pustulose ark)		74.77	1.55	3.93	3.21	2.71	4.29	Tobar-Ord3n3z (2013)
<i>Anadara tuberculosa</i>	0.30-0.56	—	—	6.60-22.61	—	—	—	Carrasco-Pe3a and Webster- Coello (2016)
<i>Anadara similis</i> (concha/ brown ark)		73.15	1.42	5.86	3.35	2.88	5.19	Carrasco-Pe3a and Webster- Coello (2016)
<i>Leukoma asperima</i>	0.35-1.86	—	0.08-0.14	10.62-16.34	—	—	—	Carrasco-Pe3a and Webster- Coello (2016)
Crustacea								
<i>Callinectes arcuatus</i> (jaiba azul/arched swim- ming crab)	0.01	—	—	—	0.08-52.17	—	—	Franco-Sol3rza- no (2015)
<i>Ucides occidentalis</i>	6.99-8.84	—	30.75-33.59	—	—	—	—	Ayala-Armijos et al. (2015)
Teleostei (fishes)								

*Organisms collected in the Gulf of Guayaquil. Scientific names follow WoRMS Editorial Board (2016)

**Other trace elements measured in sediments by Fernández-Cadena et al. (2014) in ppm: Li: 0.00785-0.0014, Be: 0.00021-0.00124, Al: 31.1545-74.2199, V: 0.09682-0.15988, Fe: 16.4711- 45.4231, Se: 0.00212-0.0348, Mo: 0.00213-0.00565, Ag: 0.00078-0.00149, Sn: 0.00121-0.00326

BDL: below detection level

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<i>Diapterus peruvians</i>	—	—	—	1.55-1.82	1.82-3.2	—	1.02-12.57	Ortega-Pereira (2015)
<i>Sardinops sagax</i>	—	57.27	—	2.22	3.72	—	9.05	“ “
Inorganic								
Water	0.01	—	—	—	—	—	—	Alcívar-Tenorio and Mosquera- Armijo (2011)
Water	0.000-0.009	—	—	—	—	—	—	Proaño-Alvara- do (2016)
Water	—	—	0.0031- 0.0090	—	—	—	—	Rivera-Pizarro (2016)
Water	0.004	—	0.001	0.00045- 0.03	0.002	—	—	Huayamave (2013)
Sediments	7.104-13.655	—	—	—	—	—	—	Proaño-Alvara- do (2016)
Sediments	—	—	—	—	—	—	—	Rivera-Pizarro (2016)
Sediments	0.03392- 0.07385	0.09395- 0.52717	0.00263- 0.0012	0.04708- 0.20651	0.02737- 0.6091	0.00565- 0.01670	0.15622- 0.40856	Fernández- Cadena et al. (2014) **

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