Predatory Bird Monitoring Scheme
http://pbms.ceh.ac.uk/

Addendum to report: Inorganic elements in the livers of the Eurasian otter, *Lutra lutra*, from England and Wales in 2007 & 2008: a Predatory Bird Monitoring Scheme report.

L.A Walker, A.J. Lawlor, E.A. Chadwick[1], E. Potter, M.G. Pereira & R.F. Shore

Centre for Ecology and Hydrology, Lancaster Environment Centre, Library Avenue, Bailrigg, Lancaster, LA1 4AP
[1]Cardiff School of Biological Sciences, Biomedical Sciences Building, Museum Avenue, Cardiff, CF10 3AX

Introduction

This addendum gives the concentrations of a selected range of metals in the livers of otters, *Lutra lutra*, found dead in England and Wales in 2007 and 2008. Analysis of these results is presented in the full report which can be down-loaded at: http://pbms.ceh.ac.uk/docs/AnnualReports/PBMS_Metals_Otters_2007-8.pdf

Methods

Metal concentrations were measured in approximately 1 g sub-samples that were dried to constant weight at 80°C for 24 h, solubilised at room temperature overnight in 2 ml of (Analar) nitric acid, then heated at 90°C for 20 min followed by 120°C for 1 h. To further digest the organic matter, 0.5 ml of 30% hydrogen peroxide was added to the sample which was then heated at 120°C for 15 min. Samples were diluted with double-deionised water to known volume and a 10% acid strength. The resulting digests were analysed for a suite of trace metals and mercury by Inductively Coupled Plasma - Mass Spectrometry (ICP-MS) using a Perkin Elmer DRCII ICP-MS with standard conditions. All metal concentrations in livers are expressed on a µg/g dry weight basis, and are not recovery corrected.

Limits of detection and % recovery data are given in table A1. Data for element concentrations in the livers for individual otters that died in 2007 and 2008 are given in tables A2 and A3 respectively.

Table A1. Inorganic elements quantified in otter livers. The method limit of detection (LoD) is given in µg/g dry weight and % recovery is the average recovery for that analyte from the Tort2 certified reference material.

Analyte	LoD	% Recovery
Aluminum (Al)	1.201	N/C
Arsenic (As)	0.016	104
Cadmium (Cd)	0.003	100
Chromium (Cr)	0.080	87.7
Cobalt (Co)	0.012	101
Copper (Cu)	0.040	90.1
Iron (Fe)	2.002	99.3
Lead (Pb)	0.120	92.1
Manganese (Mn)	0.012	93.2
Mercury (Hg)	0.200	102
Molybdenum (Mo)	0.060	108
Nickel (Ni)	0.020	89.1
Selenium (Se)	0.060	149
Strontium (Sr)	0.060	97.2
Antimony (Sb)	0.020	N/C
Zinc (Zn)	2.002	99.1

N/C indicates that the element wasn't certified in reference material.

Instrumental LoDs are calculated as 4.03 times the standard deviation of replicate blank determinations (N=6). Method LoD is based on the instrumental LoD, a dilution factor and the minimum sample weight.

Table A2. Inorganic contaminant concentrations (µg/g dry weight) in livers of Eurasian otters, *Lutra lutra*, found dead in 2007

CEH Reference	CUOP Reference	Sex	Age Class	Location (County)	Al	Mn	Fe	Co	Ni	Cu	Zn	Se	Sr	Mo	Cd	Sb	Pb	Hg	Cr	As
15983	965	F	A	Hampshire	1.78	7.64	1170	0.035	0.317	15.2	114	7.11	0.133	0.655	0.436	ND	0.333	4.7	0.137	0.329
15984	967	F	A	Tyne and Wear	1.35	4.75	1660	0.03	0.212	17	81.8	7.61	0.421	0.838	0.474	ND	2.59	4.18	0.081	0.729
15985	968	M	S/A	Tyne and Wear	2.34	9.64	408	0.223	0.081	52.3	106	8.01	0.329	1.27	0.146	ND	1.7	2.6	0.092	0.3
15986	970	M	S/A	Cumbria	2.18	7.16	1070	0.073	0.58	26.3	110	3.7	0.146	1.48	0.098	0.025	0.213	3.02	0.115	0.095
15987	976	M	A	Gwynedd	ND	7.45	578	0.067	0.113	22.6	74.2	3.9	0.223	1.29	0.81	ND	0.758	3.42	0.252	0.486
15988	982	F	S/A	Powys	1.15	8.42	284	0.079	0.042	42.3	142	6.45	0.145	1.39	0.38	ND	ND	9.46	0.092	0.186
15989	984	M	A	Shropshire	ND	5.64	437	0.05	0.073	33.9	130	5.38	0.311	1.31	0.332	ND	ND	5.92	0.152	0.105
15990*	985	M	A	Powys	1.26	7.23	571	0.034	0.097	33.3	90.2	8.68	0.06	0.977	0.523	ND	0.445	18.2	0.282	0.16
15991	986	F	A	Powys	ND	6.64	609	0.037	0.027	21.2	81.3	13.6	0.186	1.1	1.2	ND	ND	29.2	0.144	0.119
15992	987	M	A	Suffolk	1.63	6.53	943	0.04	0.038	26.4	106	5.36	0.305	1.31	0.062	ND	0.138	5.23	0.224	0.093
15993	990	F	S/A	Suffolk	1.4	8	986	0.066	0.16	12.9	90	4.27	0.177	1.32	0.083	ND	0.163	2.03	0.352	0.093
15994	996	M	A	Warwickshire	3.7	6.68	685	0.045	0.143	21	91.5	5.43	0.055	1.23	0.025	ND	ND	7.69	0.501	0.102
15995	998	M	S/A	Northumberland	ND	10.1	357	0.063	0.019	51.9	115	7.37	0.739	1.15	0.488	ND	ND	9.52	0.223	0.237
15996	999	M	A	Hampshire	ND	5.27	878	0.051	0.169	28.2	75.2	6.18	0.067	1.05	0.131	ND	ND	4.3	0.47	0.104
15997	1003	M	A	Dorset	ND	8.76	1270	0.053	0.068	28.6	83	8.68	0.337	0.935	0.064	ND	0.138	2.21	0.176	0.121
15998	1006	M	A	Powys	4.8	6.59	1200	0.098	0.109	16.8	80.9	3.14	0.171	0.871	0.629	ND	9.57	0.69	0.335	0.094
15999	1007	M	S/A	Avon	1.32	8.99	396	0.094	0.041	47.5	170	7.29	0.494	1.41	0.266	ND	ND	5.86	0.254	0.102
16000	1010	F	A	Cumbria	4.6	9.34	790	0.07	0.093	42.5	88.7	5.72	0.231	1.26	0.424	0.02	0.256	6.39	0.157	0.084
16001	1011	F	S/A	Cumbria	ND	7.91	1260	0.066	0.069	44	134	7.18	0.212	1.55	0.212	ND	0.243	11.5	0.077	0.07
16002	1012	M	A	Humberside	1.21	8.21	542	0.038	0.147	45.8	119	4.14	0.288	1.52	0.088	ND	0.334	4.96	0.095	1.17
16003	1014	M	A	Cumbria	7.2	10.1	622	0.036	0.106	50.9	98.1	6.84	0.725	1.25	1.11	ND	ND	11.3	0.107	1.11
16004	1015	M	S/A	Norfolk	1.34	7.1	637	0.049	0.157	33.3	105	5.45	0.105	1.46	0.048	ND	ND	3.49	0.08	0.044
16005	1016	M	A	Hampshire	1.72	15	690	0.067	0.11	90.8	263	8.34	0.105	1.46	0.221	ND	0.514	7.55	0.091	0.146
16006	1019	F	A	Powys	3.97	10.6	437	0.05	0.213	44.4	113	11	0.089	1.11	2.58	ND	ND	19.2	0.183	0.178
16007	1021	M	A	Cambridgeshire	1.84	11	301	0.057	0.073	38.1	115	7.51	0.271	1.52	0.037	ND	ND	4.02	0.25	0.168

ND indicates that concentrations were below the limit of detection for that element. For age-classes, A = Adult, SA = sub-adult, and J = juvenile

* Otter 15990 was found dead in 2006

Table A2 (cont..). Inorganic contaminant concentrations (µg/g dry weight) in livers of Eurasian otters, *Lutra lutra*, found dead in 2007

CEH Reference	CUOP Reference	Sex	Age Class	Location (County)	Al	Mn	Fe	Co	Ni	Cu	Zn	Se	Sr	Mo	Cd	Sb	Pb	Hg	Cr	As
16008	1025	F	S/A	Northumberland	3.02	10.5	590	0.109	0.059	47.7	118	5.33	0.089	1.58	0.189	0.019	0.32	7.93	0.106	0.093
16009	1026	F	A	Tyne And Wear	1.58	12.9	1270	0.089	0.143	17.5	175	7.35	0.264	1.38	0.888	ND	0.828	8.42	0.292	1.7
16010	1027	M	J	Tyne And Wear	2.46	20.5	601	0.345	0.213	47.5	282	6.72	0.221	1.3	0.057	ND	4.98	3.87	0.325	0.551
16011	1030	M	A	H'ford & Worc.	ND	7.41	735	0.053	0.043	39.8	107	12.6	0.334	1.44	0.119	ND	ND	25.9	0.087	0.463
16012	1031	F	S/A	Gwent	1.55	8.5	430	0.049	0.14	43	112	4.24	0.167	1.2	0.634	ND	0.123	4.41	0.207	0.219
16013	1033	M	S/A	Gwent	5.69	11.7	332	0.085	0.105	60.5	158	8.51	0.073	1.98	0.39	ND	ND	9.97	0.111	0.17
16014	1034	M	S/A	Gwent	ND	9.64	260	0.078	0.056	24.3	124	6.11	0.076	1.14	0.23	ND	0.2	6.24	0.093	0.182
16015	1038	F	S/A	North Yorkshire	1.14	6.21	1120	0.043	0.104	28.3	74.7	5.33	0.073	1.1	0.329	ND	0.777	3.94	0.186	0.054
16016*	1039	M	A	South Yorkshire	1.73	6.32	1310	0.043	0.226	30.4	122	6.59	0.311	1.54	0.421	ND	0.603	11.1	0.105	0.052
16017	1040	M	S/A	North Yorkshire	2.72	9.31	862	0.104	0.112	35.9	119	6.79	ND	1.16	0.11	ND	ND	6.47	0.203	0.053
16018	1041	F	S/A	North Yorkshire	1.36	4.7	890	0.032	0.055	57.1	75.2	4.13	ND	0.64	0.086	ND	ND	3.19	0.171	0.699
16019	1042	M	A	Devon	1.15	3.43	608	0.022	0.08	29.9	80.6	3.26	0.239	0.936	0.128	ND	ND	2.25	0.116	0.056
16020	1044	F	A	Somerset	4.27	8.05	707	0.044	0.087	22.2	82.2	5.13	ND	1.3	0.433	ND	ND	6.23	0.111	0.682
16021	1045	M	S/A	Somerset	1.2	9.34	893	0.108	0.058	38.6	138	4.31	ND	1.04	0.246	ND	0.168	3.6	0.102	0.038
16022	1048	F	S/A	Somerset	1.66	9.09	433	0.087	0.127	29.7	106	5.69	ND	1.07	0.496	ND	ND	3.79	0.288	0.112
16023	1049	M	S/A	Somerset	2.02	6.21	568	0.055	0.116	28.2	84	6.32	0.125	1.17	0.083	ND	ND	3.27	0.082	0.049
16024	1051	F	A	Somerset	1.33	8.31	1090	0.032	0.107	20.8	83.9	5.99	0.128	1.05	0.119	ND	ND	7.39	0.28	0.096
16025	1052	M	S/A	Somerset	5.72	7.26	731	0.06	0.094	25.7	104	9.62	0.099	1.01	0.09	ND	ND	3.82	0.102	0.128
16026	1053	F	A	Somerset	3.81	8.3	838	0.057	0.079	13.6	79.3	9.58	0.104	0.969	0.788	ND	0.246	14.9	0.228	0.129
16027	1054	M	A	Somerset	1.2	5.46	1420	0.042	0.124	24.8	96.8	7.63	ND	1.04	0.713	ND	ND	11.4	0.278	0.061
16028	1058	F	S/A	Cumbria	5.66	12.9	437	0.089	0.032	55.9	132	6.1	ND	1.48	0.891	ND	0.299	8.94	0.091	0.199
16029	1060	F	J	Cumbria	9.59	17.6	495	0.157	0.346	27.6	243	3.7	ND	0.919	0.027	ND	1.69	1.17	0.27	0.185
16030	1066	M	A	H'ford & Worc.	2.77	7.26	475	0.027	0.187	31.2	96	4.79	0.307	0.96	0.376	ND	0.418	6.65	0.381	0.121
16031	1067	F	S/A	H'ford & Worc.	1.46	13.9	760	0.058	0.044	16.7	244	3.53	0.083	1.73	0.217	ND	0.304	0.749	0.072	0.046
16032	1073	F	A	Cumbria	2.28	21.1	821	0.22	0.031	23.2	127	9.01	0.157	2.95	1.28	ND	ND	2.12	0.475	0.06

ND indicates that concentrations were below the limit of detection for that element. For age-classes, A = Adult, SA = sub-adult, and J = juvenile

* Otter 16016 was found dead in 2006

Table A3. Inorganic contaminant concentrations (µg/g dry weight) in livers of Eurasian otters, *Lutra lutra*, found dead in 2008

CEH Reference	CUOP Reference	Sex	Age Class	Location (County)	Al	Mn	Fe	Co	Ni	Cu	Zn	Se	Sr	Mo	Cd	Sb	Pb	Hg	Cr	As
16285	1047	M	S/A	S. Glamorgan	ND	8.04	249	0.025	0.032	18.7	77.5	4.25	0.14	0.846	0.049	ND	ND	3.74	0.309	0.146
16286	1063	M	S/A	Dyfed	ND	8.8	254	0.048	0.024	35.6	82.7	4.22	0.086	1.33	0.491	ND	ND	5.27	0.196	0.094
16287	1065	F	S/A	Avon	ND	4.97	257	0.024	0.171	12.6	49.8	4.31	0.285	0.766	0.03	ND	0.158	0.896	0.546	ND
16288	1069	F	A	Somerset	ND	11.3	541	0.045	0.024	23.1	84	9.34	ND	1.28	0.476	ND	ND	2.23	0.216	0.088
16289	1078	M	J	Somerset	ND	18	406	0.073	0.062	57.2	122	5.03	0.097	1.21	0.03	ND	ND	0.773	0.263	0.053
16290	1083	F	J	Somerset	ND	12.7	276	0.053	0.038	35.2	88.1	5.64	0.081	1.25	0.019	ND	0.216	0.574	0.382	0.019
16291	1086	M	J	Somerset	ND	10.9	465	0.07	0.063	138	168	2.68	0.605	1.03	0.055	ND	ND	0.223	0.372	2.23
16292	1087	M	A	Somerset	ND	7.26	1060	0.022	0.023	24	91.7	4.51	0.096	1.28	0.083	ND	0.172	5.77	0.356	0.018
16293	1088	M	J	Powys	ND	8.8	323	0.057	3.73	88.5	119	2.77	0.209	0.62	0.025	ND	0.128	0.562	0.528	ND
16294	1089	M	J	Powys	ND	7.4	236	0.09	6.63	36.2	89	4.61	0.26	1.28	0.058	ND	2.66	2.89	0.163	0.977
16295	1090	F	A	Gwynedd	ND	9.41	419	0.044	0.072	34.1	85.2	8.59	0.35	0.96	0.452	ND	0.112	17.7	0.285	0.612
16296	1091	M	A	Dorset	ND	8.09	547	0.15	0.081	41.2	99.4	8.15	0.342	1.31	0.366	ND	ND	7.28	0.307	0.077
16297	1094	F	J	Gwynedd	ND	8.98	565	0.157	0.204	26.4	194	5.97	1.1	0.758	0.182	ND	ND	1.55	0.179	0.762
16298	1105	M	A	Norfolk	ND	7.58	481	0.025	0.087	59.1	93.5	5.55	0.249	1.35	0.204	ND	ND	8.04	0.19	0.022
16299	1116	F	A	North Yorkshire	ND	9.42	976	0.078	0.302	47.5	95	8.86	0.16	1.61	0.74	ND	ND	12.2	0.497	0.029
16300	1128	F	A	North Yorkshire	ND	11	868	0.025	3.81	24	83.9	5.4	0.159	1.29	0.869	ND	0.94	5.83	0.336	0.541
16301	1131	F	A	West Glamorgan	ND	11	1760	0.043	0.469	21.8	111	11.9	0.246	0.943	1.24	ND	ND	23.6	0.604	0.798
16302	1136	F	A	Gloucestershire	ND	4.51	783	0.026	0.282	11.8	54.1	6.28	0.131	0.754	0.424	ND	ND	8.18	0.186	1.57
16303	1138	M	A	Devon	ND	6.05	1280	0.033	0.07	20.7	81.1	9.09	0.062	0.854	0.204	ND	1.75	3.5	0.485	0.015
16304	1140	F	A	Devon	ND	11.6	528	0.071	0.152	36.2	101	11.9	0.082	1.19	0.687	ND	ND	13.5	0.361	ND
16305	1146	F	J	Gwent	ND	11.7	642	0.113	0.129	54.5	162	5.26	0.224	0.328	0.012	ND	ND	0.398	0.242	0.019
16306	1147	M	A	Hertfordshire	ND	2.75	635	0.04	0.102	29.3	91.4	6.35	0.258	1.15	0.045	ND	ND	6.75	0.328	0.045
16307	1148	F	J	Cornwall	ND	13.7	1470	0.287	0.319	22.6	200	7.8	0.116	0.288	0.009	ND	ND	ND	0.265	0.073
16308	1165	M	S/A	Cornwall	ND	5.48	808	0.167	0.073	20.6	65.3	5.08	0.232	0.873	0.136	ND	8.65	1.03	0.357	0.159
16309	1166	F	S/A	Gloucestershire	ND	6.04	840	0.04	0.568	27.9	77.5	8.76	0.174	1.01	0.097	ND	ND	7.33	0.39	0.048
16310	1168	M	S/A	S. Glamorgan	ND	8.04	249	0.025	0.032	18.7	77.5	4.25	0.14	0.846	0.049	ND	ND	3.74	0.309	0.146
16311	1169	M	S/A	Dyfed	ND	8.8	254	0.048	0.024	35.6	82.7	4.22	0.086	1.33	0.491	ND	0.763	5.27	0.196	0.094
16312	1171	F	S/A	Avon	ND	4.97	257	0.024	0.171	12.6	49.8	4.31	0.285	0.766	0.03	ND	0.75	0.896	0.546	ND

ND indicates that concentrations were below the limit of detection for that element. For age-classes, A = Adult, SA = sub-adult, and J = juvenile

Table A3 (cont..). Inorganic contaminant concentrations (µg/g dry weight) in livers of Eurasian otters, *Lutra lutra*, found dead in 2008

CEH Reference	CUOP Reference	Sex	Age Class	Location (County)	Al	Mn	Fe	Co	Ni	Cu	Zn	Se	Sr	Mo	Cd	Sb	Pb	Hg	Cr	As
16313	1175	M	A	Hampshire	ND	6.43	1010	0.048	0.05	17.8	114	6.23	0.145	0.803	0.072	ND	0.254	7.02	0.338	ND
16314	1176	M	J	Cornwall	ND	10.4	176	0.054	0.149	143	177	4.94	0.099	0.097	0.005	ND	0.645	ND	0.211	0.082
16315	1182	F	S/A	Devon	ND	20.9	6050	0.08	0.071	40.1	319	9.58	0.189	1.6	0.491	ND	0.934	10.4	0.302	0.338
16316	1184	F	A	Essex	ND	9.92	632	0.032	0.154	22.4	98.1	8.17	0.259	1.45	0.298	ND	ND	5.55	0.366	ND
16317	1190	M	A	Cumbria	ND	8.38	921	0.046	0.056	35.1	91.3	6.28	0.191	1.57	0.136	ND	ND	7.83	0.389	ND
16318	1192	M	S/A	Cumbria	ND	9.23	452	0.08	0.196	30.6	80.2	5.54	0.117	1.28	0.385	ND	1.36	3.02	0.583	0.059
16319	1200	F	S/A	Powys	ND	8.43	538	0.057	0.431	46.6	126	6.95	0.685	1.15	0.35	ND	ND	10	0.424	0.054
16320	1201	M	S/A	Shropshire	ND	6.4	289	0.062	0.037	31	95.9	2.84	0.135	0.972	0.291	ND	0.568	3.15	0.225	ND
16321	1206	M	S/A	Dorset	ND	8.33	459	0.059	0.063	23	101	5.26	0.168	1.4	0.161	ND	0.136	5.97	0.388	ND
16322	1219	F	S/A	Somerset	ND	5.75	577	0.091	0.192	25.7	83.5	7.44	0.174	1.17	0.045	ND	ND	4.01	0.261	ND
16323	1223	M	J	Gwent	ND	6.18	320	0.043	0.075	20.8	111	4.12	0.227	0.669	0.025	ND	0.214	1.26	0.173	0.943
16324	1232	F	S/A	Bedfordshire	ND	10.6	579	0.056	0.048	43.9	91.9	8.91	0.537	1.65	0.055	ND	ND	4.49	0.375	ND
16325	1234	F	S/A	Devon	ND	9.82	396	0.113	0.049	32.5	96.1	6	0.161	1.17	0.299	ND	ND	3.34	0.183	ND
16326	1236	M	A	Humberside	ND	9.1	518	0.019	0.074	18.6	92.1	4.16	0.188	1.34	0.106	ND	0.153	3.7	0.263	0.055
16327	1238	M	S/A	Gwynedd	ND	6.37	603	0.117	0.074	23.6	98.4	5.83	0.307	0.963	0.425	ND	0.202	7.36	0.099	0.149
16328	1240	F	S/A	Gwynedd	ND	7.05	940	0.072	0.08	29.5	87.9	5.84	1.48	1.2	0.489	ND	0.249	8.71	0.186	0.362
16330	1247	M	S/A	Gwynedd	ND	8.78	755	0.066	ND	26.8	98.8	6.15	0.6	1.24	0.188	ND	ND	9.55	0.269	1.07
16331	1253	F	S/A	Northumberland	ND	6.95	537	0.046	0.106	31.1	92.2	2.41	0.287	1.53	0.157	ND	0.151	0.511	0.262	ND
16332	1254	M	S/A	Hampshire	ND	9.98	263	0.059	0.095	37.9	134	7.76	0.104	1.4	0.051	ND	ND	3.33	0.397	0.388
16333	1262	F	A	Northamptonshire	1.16	11.1	515	0.05	0.071	11.8	71.5	5.82	0.108	1.07	0.137	ND	ND	7.92	0.302	ND
16334	1267	M	A	North Yorkshire	ND	5.78	593	0.021	0.054	58.8	117	5.19	0.125	1.48	0.201	ND	ND	4.66	0.229	0.896
16335	1268	M	S/A	West Yorkshire	ND	8.12	452	0.056	0.082	30.9	93	6.09	0.172	1.25	0.458	ND	1.47	1.95	0.258	0.146
16336	1279	M	S/A	Devon	ND	10.5	293	0.041	0.051	20	87.1	6.54	0.164	1.18	0.342	ND	0.256	3	0.185	0.078
16337	1287	F	J	Lincolnshire	ND	16.4	1480	0.097	0.143	15	208	4.49	0.327	0.858	0.018	ND	0.582	0.624	0.143	ND
16338	1298	F	A	Cumbria	ND	9.87	884	0.054	0.053	23.4	77.7	8.45	0.219	1.02	0.789	ND	4.2	6.1	0.188	ND
16339	1303	M	S/A	Devon	ND	9.13	233	0.209	0.024	22.2	80.4	4.53	0.248	1.27	0.103	ND	1.84	1.23	0.306	2.27
16340	1335	F	A	Shropshire	ND	10.4	524	0.038	0.022	49.4	98	5.88	0.131	1.33	0.353	ND	ND	5.22	0.32	ND
16341	1338	F	S/A	Dyfed	ND	11.1	730	0.112	0.053	40.2	105	5.89	1.3	1.46	0.109	ND	ND	3.99	0.336	2.08
16342	1341	F	A	Dyfed	ND	10.7	489	0.059	0.074	47.4	90.2	7	0.186	1.28	0.325	ND	ND	11.3	0.232	0.02

ND indicates that concentrations were below the limit of detection for that element. For age-classes, A = Adult, SA = sub-adult, and J = juvenile