APPENDIX E

Estimation Models for Metals in Small Mammal Liver and Kidney Tissue

APPENDIX E

Estimation Models for Metals in Small Mammal Liver and Kidney Tissue

Tissue-based exposures consist of concentrations of COPECs in tissues of receptor species that are the focus of contaminant toxicity. These concentrations may be measured directly from field-collected birds and/or mammals or they may be modeled using site-specific or literature-derived information. They can then be compared to available literature information for concentrations of chemicals in specific tissues that are associated with adverse effects. This provides another measure of the potential nature and magnitude of effects small mammals may experience at the ASARCO LLC, Hayden Plant Site.

Previous research has shown that concentrations of chemicals in small mammal tissues may be estimated based on soil concentrations (Sample et al. 1998, Shore 1995). Thus, soil-to-liver and soil-to-kidney bioaccumulation models were developed for small mammals based on literature-derived data. Using an approach comparable to that employed in Sample et al. (1998), co-located soil and small mammal organ concentration data were extracted from published studies. Tables E-1 and E-2 provide a summary of the liver and kidney data, respectively, used for model development. Log-linear regression models were developed for all small mammals combined, and for specific trophic guilds (e.g., insectivores, herbivores, and omnivores). Tables E-3 and E-4 summarize soil-to-liver and soil-to-kindey regression models, respectively.

Models with r-square values of 0.2 or greater were applied to soil data from the ASARCO Site to generate estimated concentrations of arsenic, cadmium, copper, lead, mercury, and zinc in tissues of insectivorous and herbivorous small mammals, as possible (Section 3, Table 3-7). Estimates for herbivorous small mammals are assumed to be representative of Desert cottontails. Estimates for insectivorous small mammals are assumed to be representative of desert shrews.

TABLE E-1

Summary of Literature-derived Soil Small Mammal Liver Bioaccumulation Data

Analyte	Study Location	Species	Trophic Group	Mean Tissue Conc mg/kg dry wt	Soil Conc mg/kg dry wt	Reference
As	Utah	S.varigatus	O	0.1	14	Sharma and Shupe 1977
As	Utah	S.varigatus	O	8.2	34.3	Sharma and Shupe 1977
As	Utah	S.varigatus	O	3.7	25.5	Sharma and Shupe 1977
As	Utah	S.varigatus	O	0.8	21.6	Sharma and Shupe 1977
As	Utah	S.varigatus	O	4.6	15.5	Sharma and Shupe 1977
As	Utah	S.varigatus	O	3.3	7.9	Sharma and Shupe 1977
As	Utah	S.varigatus	O	0.5	16.2	Sharma and Shupe 1977
As	Utah	S.varigatus	O	0.7	24.2	Sharma and Shupe 1977
As	Utah	S.varigatus	O	9.4	9.9	Sharma and Shupe 1977
As	Utah	S.varigatus	O	2	16.5	Sharma and Shupe 1977
As	Utah	S.varigatus	O	7	10.4	Sharma and Shupe 1977
As	Utah	S.varigatus	O	0.8	16.8	Sharma and Shupe 1977
As	Utah	S.varigatus	O	5.1	14.3	Sharma and Shupe 1977
As	Utah	S.varigatus	O	6.5	59.2	Sharma and Shupe 1977
As	Utah	S.varigatus	O	6	60.3	Sharma and Shupe 1977
As	Utah	S.varigatus	O	7.4	654.6	Sharma and Shupe 1977
As	Utah	S.varigatus	O	1.3	18.1	Sharma and Shupe 1977
Cd	GreatBritain	S.araneus-imm	C	9.11	3.3	Read and Martin 1993
Cd	GreatBritain	S.minutus-imm	C	12.58	3.3	Read and Martin 1993
Cd	GreatBritain	S.minutus-ad	C	21.7	1.7	Read and Martin 1993
Cd	GreatBritain	S.minutus-ad	C	10.72	2	Read and Martin 1993
Cd	GreatBritain	S.araneus	C	25.4	0.75	Hunter and Johnson 1982
Cd	GreatBritain	S.minutus-imm	C	25.03	19.9	Read and Martin 1993
Cd	GreatBritain	S.araneus-ad	C	46.2	1	Read and Martin 1993
Cd	GreatBritain	S.minutus-imm	C	7.36	1.7	Read and Martin 1993
Cd	GreatBritain	S.araneus-ad	C	14.36	0.6	Read and Martin 1993
Cd	GreatBritain	S.minutus-ad	C	63.7	19.9	Read and Martin 1993
Cd	GreatBritain	S.minutus-ad	C	13.15	0.6	Read and Martin 1993
Cd	GreatBritain	S.araneus	C	2.85	0	Andrews et al. 1984
Cd	GreatBritain	S.araneus-ad	C	452	19.9	Read and Martin 1993
Cd	GreatBritain	S.araneus	C	237.3	3.1	Hunter and Johnson 1982
Cd	GreatBritain	S.araneus-imm	C	13.49	1.7	Read and Martin 1993
Cd	GreatBritain	S.araneus-ad	C	68	1.7	Read and Martin 1993
Cd	GreatBritain	S.araneus-imm	C	11.87	2	Read and Martin 1993
Cd	GreatBritain	S.araneus-ad	C	164	3.3	Read and Martin 1993
Cd	GreatBritain	S.araneus-imm	C	111.8	19.9	Read and Martin 1993
Cd	GreatBritain	S.araneus-imm	C	4.3	1	Read and Martin 1993
Cd	GreatBritain	S.araneus-ad	C	14.9	2	Read and Martin 1993
Cd	GreatBritain	S.minutus-imm	C	2.22	1	Read and Martin 1993
Cd	GreatBritain	S.araneus	C	235.8	0	Andrews et al. 1984
Cd	GreatBritain	S.minutus-ad	C	7.37	1	Read and Martin 1993
Cd	GreatBritain	S.araneus-imm	C	7.37	0.6	Read and Martin 1993
Cd	GreatBritain	S.minutus-imm	C	5.14	0.6	Read and Martin 1993
Cd	GreatBritain	S.minutus-ad	C	29.57	3.3	Read and Martin 1993
Cd	GreatBritain	S.araneus	C	280	8.5	Hunter and Johnson 1982
Cd	GreatBritain	S.minutus-imm	C	3.25	2	Read and Martin 1993
Cd	GreatBritain	A.sylvaticus	H	0.51	0.75	Hunter and Johnson 1982
Cd	Montana	M.pennsylvanicus	H	1.5625	7.8	Pascoe et al. 1994, 1996
Cd	GreatBritain	M.agrestis	H	1.42	3.1	Hunter and Johnson 1982
Cd	GreatBritain	M.agrestis	H	1	0	Beardsley et al. 1978
Cd	Ohio	M.pennsylvanicus	H	0.00075	2.28	Tighlman-Hall et al. 1990
Cd	GreatBritain	C.glareolus	H	5.1	11.2	Johnson et al. 1978
Cd	Ohio	M.pennsylvanicus	H	0.00025	0.06	Tighlman-Hall et al. 1990
Cd	GreatBritain	A.sylvaticus	H	4.36	45.9	Johnson et al. 1978
Cd	Ohio	M.pennsylvanicus	H	0.00015625	0.06	Tighlman-Hall et al. 1990
Cd	GreatBritain	C.glareolus	H	1.14	1.55	Johnson et al. 1978
Cd	GreatBritain	A.sylvaticus	H	0.66	1.1	Johnson et al. 1978
Cd	GreatBritain	M.agrestis	H	0.66	0.75	Hunter and Johnson 1982
Cd	Ohio	M.pennsylvanicus	H	0.00078125	2.28	Tighlman-Hall et al. 1990
Cd	GreatBritain	M.agrestis	H	1.88	0	Andrews et al. 1984
Cd	GreatBritain	M.agrestis	H	7.71	8.5	Hunter and Johnson 1982
Cd	GreatBritain	A.sylvaticus	H	1.46	8.5	Hunter and Johnson 1982
Cd	GreatBritain	M.agrestis	H	1.14	0	Andrews et al. 1984
Cd	GreatBritain	A.sylvaticus	H	9.84	92.2	Johnson et al. 1978
Cd	Pennsylvania	M.pennsylvanicus	H	0.27	0.09	Alberici et al. 1989
Cd	GreatBritain	A.sylvaticus	H	0.86	1.55	Johnson et al. 1978
Cd	Pennsylvania	M.pennsylvanicus	H	0.23	0.06	Alberici et al. 1989

TABLE E-1

Summary of Literature-derived Soil Small Mammal Liver Bioaccumulation Data

Analyte	Study Location	Species	Trophic Group	Mean Tissue Conc mg/kg dry wt	Soil Conc mg/kg dry wt	Reference
Cd	GreatBritain	M.agrestis	H	1.06	11.2	Johnson et al. 1978
Cd	GreatBritain	A.sylvaticus	H	0.48	1.44	Johnson et al. 1978
Cd	GreatBritain	M.agrestis	H	0.27	1.55	Johnson et al. 1978
Cd	Pennsylvania	S.floridanus	H	2.4	0.4	Dressler et al. 1986
Cd	GreatBritain	A.sylvaticus	H	2.49	11.2	Johnson et al. 1978
Cd	GreatBritain	A.sylvaticus	H	1.38	3.1	Hunter and Johnson 1982
Cd	GreatBritain	M.agrestis	H	5	0	Beardsley et al. 1978
Cd	Pennsylvania	S.floridanus	H	1.6	0.1	Dressler et al. 1986
Cd	Utah	S.varigatus	O	3.7	4	Sharma and Shupe 1977
Cd	Utah	S.varigatus	O	5.3	9.9	Sharma and Shupe 1977
Cd	Utah	S.varigatus	O	3.2	3.4	Sharma and Shupe 1977
Cd	Utah	S.varigatus	O	2	2.4	Sharma and Shupe 1977
Cd	Utah	S.varigatus	O	26.7	9.8	Sharma and Shupe 1977
Cd	Utah	S.varigatus	O	6.6	3.2	Sharma and Shupe 1977
Cd	Utah	S.varigatus	O	5.6	5.2	Sharma and Shupe 1977
Cd	Utah	S.varigatus	O	10.8	4	Sharma and Shupe 1977
Cd	Utah	S.varigatus	O	4.5	1.8	Sharma and Shupe 1977
Cd	Utah	S.varigatus	O	5.3	3.4	Sharma and Shupe 1977
Cd	Utah	S.varigatus	O	4.2	2.4	Sharma and Shupe 1977
Cd	BritishColumbia	P.maniculatus	O	0.35	5.62	Laurinolli and Bendell-Young 1996
Cd	Utah	S.varigatus	O	2.4	2.9	Sharma and Shupe 1977
Cd	Montana	P.maniculatus	O	0.9375	7.8	Pascoe et al. 1994, 1996
Cd	Utah	S.varigatus	O	4.2	2.2	Sharma and Shupe 1977
Cd	BritishColumbia	P.maniculatus	O	0.74	5.02	Laurinolli and Bendell-Young 1996
Cd	BritishColumbia	P.maniculatus	O	0.18	0.68	Laurinolli and Bendell-Young 1996
Cd	Utah	S.varigatus	O	3.2	3.3	Sharma and Shupe 1977
Cd	Utah	S.varigatus	O	5.7	3.1	Sharma and Shupe 1977
Cd	Utah	S.varigatus	O	1.3	4	Sharma and Shupe 1977
Cd	Utah	S.varigatus	O	5.7	4.1	Sharma and Shupe 1977
Co	Pennsylvania	S.floridanus	H	0.2	1	Dressler et al. 1986
Co	Pennsylvania	M.pennsylvanicus	H	0.49	1.37	Alberici et al. 1989
Co	Pennsylvania	M.pennsylvanicus	H	0.4	0.15	Alberici et al. 1989
Cr	Pennsylvania	M.pennsylvanicus	H	0.37	0.91	Alberici et al. 1989
Cr	GreatBritain	M.agrestis	H	0.5	0	Beardsley et al. 1978
Cr	GreatBritain	M.agrestis	H	0.3	0	Beardsley et al. 1978
Cr	Pennsylvania	M.pennsylvanicus	H	0.43	0.24	Alberici et al. 1989
Cu	GreatBritain	S.araneus-imm	C	14.67	18	Read and Martin 1993
Cu	GreatBritain	S.araneus-ad	C	28.75	24	Read and Martin 1993
Cu	GreatBritain	S.araneus-ad	C	22.9	12	Read and Martin 1993
Cu	GreatBritain	S.minutus-ad	C	19.46	151	Read and Martin 1993
Cu	GreatBritain	S.araneus	C	56.2	246	Hunter and Johnson 1982
Cu	GreatBritain	S.araneus	C	31.1	9.3	Hunter and Johnson 1982
Cu	GreatBritain	S.minutus-imm	C	11.61	14	Read and Martin 1993
Cu	GreatBritain	S.minutus-ad	C	22.7	18	Read and Martin 1993
Cu	GreatBritain	S.minutus-imm	C	7.51	24	Read and Martin 1993
Cu	GreatBritain	S.minutus-ad	C	15.04	12	Read and Martin 1993
Cu	GreatBritain	S.araneus-imm	C	9.57	24	Read and Martin 1993
Cu	GreatBritain	S.araneus	C	56.1	2480	Hunter and Johnson 1982
Cu	GreatBritain	S.minutus-imm	C	15.21	18	Read and Martin 1993
Cu	GreatBritain	S.araneus-ad	C	23.24	14	Read and Martin 1993
Cu	GreatBritain	S.minutus-imm	C	25.52	18	Read and Martin 1993
Cu	GreatBritain	S.minutus-ad	C	14.5	14	Read and Martin 1993
Cu	GreatBritain	S.araneus-ad	C	11.19	18	Read and Martin 1993
Cu	GreatBritain	S.araneus-imm	C	11.58	14	Read and Martin 1993
Cu	GreatBritain	S.araneus-imm	C	23.25	18	Read and Martin 1993
Cu	GreatBritain	S.minutus-ad	C	14.89	24	Read and Martin 1993
Cu	GreatBritain	S.araneus-ad	C	20.85	18	Read and Martin 1993
Cu	GreatBritain	S.minutus-imm	C	12.45	12	Read and Martin 1993
Cu	GreatBritain	S.minutus-imm	C	31.8	151	Read and Martin 1993
Cu	GreatBritain	S.araneus-imm	C	14.82	12	Read and Martin 1993
Cu	GreatBritain	S.araneus-ad	C	23.32	151	Read and Martin 1993
Cu	GreatBritain	S.araneus-imm	C	32.5	151	Read and Martin 1993
Cu	GreatBritain	S.minutus-ad	C	18.74	18	Read and Martin 1993
Cu	Ohio	M.pennsylvanicus	H	8.90625	24.19	Tighlman-Hall et al. 1990
Cu	Ohio	M.pennsylvanicus	H	9.09375	5.33	Tighlman-Hall et al. 1990
Cu	GreatBritain	M.agrestis	H	13.4	9.3	Hunter and Johnson 1982
Cu	GreatBritain	M.agrestis	H	13.7	246	Hunter and Johnson 1982

TABLE E-1

Summary of Literature-derived Soil Small Mammal Liver Bioaccumulation Data

Analyte	Study Location	Species	Trophic Group	Mean Tissue Conc mg/kg dry wt	Soil Conc mg/kg dry wt	Reference
Cu	Ohio	M.pennsylvanicus	H	9.5625	24.19	Tighlman-Hall et al. 1990
Cu	GreatBritain	A.sylvaticus	H	12.9	9.3	Hunter and Johnson 1982
Cu	GreatBritain	A.sylvaticus	H	23.7	2480	Hunter and Johnson 1982
Cu	GreatBritain	M.agrestis	H	13.5	2480	Hunter and Johnson 1982
Cu	Pennsylvania	M.pennsylvanicus	H	13.36	2.92	Alberici et al. 1989
Cu	Pennsylvania	M.pennsylvanicus	H	13.6	2.47	Alberici et al. 1989
Cu	GreatBritain	A.sylvaticus	H	12.6	246	Hunter and Johnson 1982
Cu	Montana	M.pennsylvanicus	H	13.125	532.2	Pascoe et al. 1994, 1996
Cu	Ohio	M.pennsylvanicus	H	12.0625	5.33	Tighlman-Hall et al. 1990
Cu	Ontario	M.pennsylvanicus	H	16	38	Cloutier et al. 1985
Cu	GreatBritain	M.agrestis	H	50	0	Beardsley et al. 1978
Cu	Ontario	M.pennsylvanicus	H	28	400	Cloutier et al. 1985
Cu	Pennsylvania	S.floridanus	H	11	2.9	Dressler et al. 1986
Cu	Ontario	M.pennsylvanicus	H	14.5	30	Cloutier et al. 1985
Cu	Pennsylvania	S.floridanus	H	11.8	6.7	Dressler et al. 1986
Cu	GreatBritain	M.agrestis	H	16	0	Beardsley et al. 1978
Cu	BritishColumbia	P.maniculatus	O	17.4	63.4	Laurinolli and Bendell-Young 1996
Cu	Montana	P.maniculatus	O	17.8125	532.2	Pascoe et al. 1994, 1996
Cu	BritishColumbia	P.maniculatus	O	29.4	252.9	Laurinolli and Bendell-Young 1996
Cu	BritishColumbia	P.maniculatus	O	52.9	293	Laurinolli and Bendell-Young 1996
F	GreatBritain	S.araneus	C	12	98876	Andrews et al. 1989b
F	GreatBritain	S.araneus	C	8.52	131.2	Andrews et al. 1989b
F	GreatBritain	M.agrestis	H	11.3	98876	Andrews et al. 1989b
F	GreatBritain	M.agrestis	H	6.48	131.2	Andrews et al. 1989b
Fe	Ontario	M.pennsylvanicus	H	1450	100000	Cloutier et al. 1985
Fe	Ontario	M.pennsylvanicus	H	425	8000	Cloutier et al. 1985
Fe	Ontario	M.pennsylvanicus	H	350	22000	Cloutier et al. 1985
Hg	Georgia	S.hispidus	H	3.8	0.63	Gardner et al. 1978
Hg	GreatBritain	C.glareolus	H	0.46875	3.81	Bull et al. 1977
Hg	GreatBritain	A.sylvaticus	H	0.125	0.106	Bull et al. 1977
Hg	GreatBritain	A.sylvaticus	H	0.71875	3.81	Bull et al. 1977
Hg	GreatBritain	C.glareolus	H	0.1875	0.106	Bull et al. 1977
Hg	Georgia	D.marsupialis	O	13	0.63	Gardner et al. 1978
Hg	Georgia	P.lotor	O	8	0.63	Gardner et al. 1978
Hg	Georgia	R.norvegicus	O	15	0.63	Gardner et al. 1978
Mn	GreatBritain	M.agrestis	H	8	0	Beardsley et al. 1978
Mn	GreatBritain	M.agrestis	H	10	0	Beardsley et al. 1978
Ni	Pennsylvania	S.floridanus	H	0.1	2.2	Dressler et al. 1986
Ni	Pennsylvania	M.pennsylvanicus	H	0.3	2.21	Alberici et al. 1989
Ni	Pennsylvania	M.pennsylvanicus	H	0.21	0.77	Alberici et al. 1989
Ni	Pennsylvania	S.floridanus	H	0.2	3.1	Dressler et al. 1986
Pb	GreatBritain	S.minutus-imm	C	2.7	50	Read and Martin 1993
Pb	GreatBritain	S.araneus-imm	C	15.3	1142	Read and Martin 1993
Pb	GreatBritain	S.minutus-ad	C	4.2	138	Read and Martin 1993
Pb	GreatBritain	S.minutus-imm	C	2.8	125	Read and Martin 1993
Pb	NewJersey	B.brevicauda	C	0.46	74	Stansley and Roscoe 1996
Pb	GreatBritain	S.minutus-ad	C	2.6	98	Read and Martin 1993
Pb	GreatBritain	S.minutus-imm	C	3.2	98	Read and Martin 1993
Pb	GreatBritain	S.araneus-ad	C	41.8	1142	Read and Martin 1993
Pb	GreatBritain	S.minutus-ad	C	3.1	125	Read and Martin 1993
Pb	GreatBritain	S.araneus-ad	C	5.6	125	Read and Martin 1993
Pb	GreatBritain	S.minutus-imm	C	6.3	1142	Read and Martin 1993
Pb	GreatBritain	S.minutus-ad	C	14	1142	Read and Martin 1993
Pb	GreatBritain	S.araneus-imm	C	2.8	138	Read and Martin 1993
Pb	NewJersey	B.brevicauda	C	34.1	75000	Stansley and Roscoe 1996
Pb	GreatBritain	S.minutus-imm	C	5.4	138	Read and Martin 1993
Pb	GreatBritain	S.araneus	C	17.2	0	Chmiel and Harrison 1981
Pb	GreatBritain	S.araneus-imm	C	8.7	98	Read and Martin 1993
Pb	GreatBritain	S.minutus-ad	C	0.9	33	Read and Martin 1993
Pb	GreatBritain	S.araneus-imm	C	1.7	33	Read and Martin 1993
Pb	GreatBritain	S.minutus-imm	C	1.3	33	Read and Martin 1993
Pb	GreatBritain	S.araneus-ad	C	1.5	33	Read and Martin 1993
Pb	GreatBritain	S.araneus-ad	C	5.1	138	Read and Martin 1993
Pb	GreatBritain	S.araneus-ad	C	2.1	50	Read and Martin 1993
Pb	GreatBritain	S.minutus-ad	C	1.9	50	Read and Martin 1993
Pb	GreatBritain	S.araneus-ad	C	0.5	98	Read and Martin 1993
Pb	GreatBritain	S.araneus-imm	C	3.9	125	Read and Martin 1993

TABLE E-1

Summary of Literature-derived Soil Small Mammal Liver Bioaccumulation Data

Analyte	Study Location	Species	Trophic Group	Mean Tissue Conc mg/kg dry wt	Soil Conc mg/kg dry wt	Reference
Pb	GreatBritain	S.araneus-imm	C	1.5	50	Read and Martin 1993
Pb	Ontario	M.pennsylvanicus	H	2	60	Cloutier et al. 1985
Pb	GreatBritain	A.sylvaticus	H	7.85	96.3	Johnson et al. 1978
Pb	GreatBritain	A.sylvaticus	H	6.63	76.1	Johnson et al. 1978
Pb	GreatBritain	A.sylvaticus	H	11.7	8430	Johnson et al. 1978
Pb	Ohio	M.pennsylvanicus	H	2.375	43.48	Tighlman-Hall et al. 1990
Pb	GreatBritain	M.agrestis	H	3	0	Beardsley et al. 1978
Pb	GreatBritain	A.sylvaticus	H	12.1	4030	Johnson et al. 1978
Pb	GreatBritain	C.glareolus	H	7	78	Johnson et al. 1978
Pb	Ohio	M.pennsylvanicus	H	2.09375	43.48	Tighlman-Hall et al. 1990
Pb	GreatBritain	A.sylvaticus	H	5.37	78	Johnson et al. 1978
Pb	Pennsylvania	M.pennsylvanicus	H	0.41	0.88	Alberici et al. 1989
Pb	NewYork	M.pennsylvanicus	H	1.7	14.2	Haschek et al. 1979
Pb	NewYork	M.pennsylvanicus	H	3.4	1342	Haschek et al. 1979
Pb	Ohio	M.pennsylvanicus	H	2.4375	19.32	Tighlman-Hall et al. 1990
Pb	NewYork	M.pennsylvanicus	H	4.1	1342	Haschek et al. 1979
Pb	Ontario	M.pennsylvanicus	H	2.5	200	Cloutier et al. 1985
Pb	NewYork	M.pennsylvanicus	H	10.5	6326	Haschek et al. 1979
Pb	Ohio	M.pennsylvanicus	H	2.40625	19.32	Tighlman-Hall et al. 1990
Pb	NewYork	M.pinetorum	H	5.5	6326	Haschek et al. 1979
Pb	NewYork	M.pennsylvanicus	H	3	1342	Haschek et al. 1979
Pb	GreatBritain	M.agrestis	H	4.67	78	Johnson et al. 1978
Pb	NewYork	M.pennsylvanicus	H	2	14.2	Haschek et al. 1979
Pb	NewYork	M.pennsylvanicus	H	1.3	14.2	Haschek et al. 1979
Pb	Pennsylvania	S.floridanus	H	0.8	3.5	Dressler et al. 1986
Pb	GreatBritain	M.agrestis	H	13.7	14010	Johnson et al. 1978
Pb	Pennsylvania	M.pennsylvanicus	H	2.5	2.67	Alberici et al. 1989
Pb	NewYork	M.pennsylvanicus	H	9	6326	Haschek et al. 1979
Pb	GreatBritain	A.sylvaticus	H	13	14010	Johnson et al. 1978
Pb	GreatBritain	C.glareolus	H	10.4	14010	Johnson et al. 1978
Pb	NewYork	M.pinetorum	H	8.3	6326	Haschek et al. 1979
Pb	GreatBritain	A.sylvaticus	H	8.5	0	Chmiel and Harrison 1981
Pb	GreatBritain	C.glareolus	H	16.5	0	Chmiel and Harrison 1981
Pb	GreatBritain	A.sylvaticus	H	3.5	0	Chmiel and Harrison 1981
Pb	Pennsylvania	S.floridanus	H	0.2	2.7	Dressler et al. 1986
Pb	NewYork	M.pennsylvanicus	H	1.6	14.2	Haschek et al. 1979
Pb	GreatBritain	M.agrestis	H	4	0	Beardsley et al. 1978
Pb	NewYork	M.pennsylvanicus	H	4.9	1342	Haschek et al. 1979
Pb	Ontario	M.pennsylvanicus	H	3	30	Cloutier et al. 1985
Pb	NewYork	M.pennsylvanicus	H	4.8	1342	Haschek et al. 1979
Pb	Utah	S.varigatus	O	9.2	1126.8	Sharma and Shupe 1977
Pb	Kansas	P.maniculatus	O	2.33	24	Kisseberth et al. 1984
Pb	Kansas	P.maniculatus	O	0.69	18	Kisseberth et al. 1984
Pb	NewJersey	P.leucopus	O	0.98	74	Stansley and Roscoe 1996
Pb	Utah	S.varigatus	O	4.3	252.6	Sharma and Shupe 1977
Pb	NewJersey	P.leucopus	O	4.98	75000	Stansley and Roscoe 1996
Pb	Kansas	P.maniculatus	O	6.94	38	Kisseberth et al. 1984
Pb	Utah	S.varigatus	O	5.6	222.5	Sharma and Shupe 1977
Pb	Kansas	P.maniculatus	O	0.99	8	Kisseberth et al. 1984
Pb	Utah	S.varigatus	O	4	17	Sharma and Shupe 1977
Pb	Kansas	P.maniculatus	O	0.75	14	Kisseberth et al. 1984
Pb	Kansas	P.maniculatus	O	4.19	62	Kisseberth et al. 1984
Pb	Kansas	P.maniculatus	O	0.76	38	Kisseberth et al. 1984
Pb	NewYork	P.leucopus	O	2.1	6326	Haschek et al. 1979
Pb	Utah	S.varigatus	O	2.6	133.2	Sharma and Shupe 1977
Pb	Utah	S.varigatus	O	2.8	230.7	Sharma and Shupe 1977
Pb	Utah	S.varigatus	O	2.7	1399.4	Sharma and Shupe 1977
Pb	Utah	S.varigatus	O	4.4	192.6	Sharma and Shupe 1977
Pb	Utah	S.varigatus	O	1.6	61.4	Sharma and Shupe 1977
Pb	Kansas	P.maniculatus	O	0.71	12	Kisseberth et al. 1984
Pb	Utah	S.varigatus	O	6.3	32.5	Sharma and Shupe 1977
Pb	Utah	S.varigatus	O	4.2	183.3	Sharma and Shupe 1977
Pb	NewYork	P.leucopus	O	5.7	6326	Haschek et al. 1979
Pb	Colorado	P.maniculatus	O	1.06	26.6	Mierau and Favara 1975
Pb	Utah	S.varigatus	O	1.4	85.9	Sharma and Shupe 1977
Pb	Utah	S.varigatus	O	1.8	67	Sharma and Shupe 1977
Pb	Utah	S.varigatus	O	1.9	172.8	Sharma and Shupe 1977

TABLE E-1

Summary of Literature-derived Soil Small Mammal Liver Bioaccumulation Data

Analyte	Study Location	Species	Trophic Group	Mean Tissue Conc mg/kg dry wt	Soil Conc mg/kg dry wt	Reference
Pb	Kansas	P.maniculatus	O	0.45	19	Kisseberth et al. 1984
Pb	Utah	S.varigatus	O	4.9	228.5	Sharma and Shupe 1977
Pb	Colorado	P.maniculatus	O	3.29	73	Mierau and Favara 1975
Pb	Utah	S.varigatus	O	5.5	223.1	Sharma and Shupe 1977
Pb	Kansas	P.maniculatus	O	0.75	19	Kisseberth et al. 1984
Pb	Utah	S.varigatus	O	2.2	417.6	Sharma and Shupe 1977
Zn	GreatBritain	S.minutus-ad	C	96	112	Read and Martin 1993
Zn	GreatBritain	S.araneus-ad	C	97	74	Read and Martin 1993
Zn	GreatBritain	S.araneus-imm	C	84	74	Read and Martin 1993
Zn	GreatBritain	S.araneus-ad	C	145	257	Read and Martin 1993
Zn	GreatBritain	S.minutus-ad	C	121	1389	Read and Martin 1993
Zn	GreatBritain	S.minutus-ad	C	88	159	Read and Martin 1993
Zn	GreatBritain	S.araneus-imm	C	249	159	Read and Martin 1993
Zn	GreatBritain	S.araneus-imm	C	158	1389	Read and Martin 1993
Zn	GreatBritain	S.araneus-imm	C	75	112	Read and Martin 1993
Zn	GreatBritain	S.araneus-ad	C	197	1389	Read and Martin 1993
Zn	GreatBritain	S.minutus-imm	C	63	112	Read and Martin 1993
Zn	GreatBritain	S.minutus-imm	C	100	193	Read and Martin 1993
Zn	GreatBritain	S.minutus-imm	C	136	159	Read and Martin 1993
Zn	GreatBritain	S.araneus-imm	C	73	257	Read and Martin 1993
Zn	GreatBritain	S.minutus-imm	C	85	257	Read and Martin 1993
Zn	GreatBritain	S.minutus-ad	C	100	257	Read and Martin 1993
Zn	GreatBritain	S.araneus-ad	C	127	112	Read and Martin 1993
Zn	GreatBritain	S.minutus-ad	C	116	193	Read and Martin 1993
Zn	GreatBritain	S.minutus-imm	C	110	74	Read and Martin 1993
Zn	GreatBritain	S.minutus-imm	C	94	1389	Read and Martin 1993
Zn	GreatBritain	S.araneus	C	169	61.9	Andrews et al. 1989a
Zn	GreatBritain	S.araneus-ad	C	143	193	Read and Martin 1993
Zn	GreatBritain	S.araneus	C	180	1925	Andrews et al. 1989a
Zn	GreatBritain	S.araneus-imm	C	140	193	Read and Martin 1993
Zn	GreatBritain	S.araneus-ad	C	54	159	Read and Martin 1993
Zn	GreatBritain	S.minutus-ad	C	87	74	Read and Martin 1993
Zn	GreatBritain	A.sylvaticus	H	133	131	Johnson et al. 1978
Zn	GreatBritain	M.agrestis	H	149	0	Beardsley et al. 1978
Zn	Ohio	M.pennsylvanicus	H	69.125	90.25	Tighlman-Hall et al. 1990
Zn	GreatBritain	A.sylvaticus	H	84.8	21000	Johnson et al. 1978
Zn	Montana	M.pennsylvanicus	H	87.8125	1908.9	Pascoe et al. 1994, 1996
Zn	Ontario	M.pennsylvanicus	H	70	90	Cloutier et al. 1985
Zn	Pennsylvania	M.pennsylvanicus	H	81.26	1.5	Alberici et al. 1989
Zn	Pennsylvania	S.floridanus	H	110	1.5	Dressler et al. 1986
Zn	Ontario	M.pennsylvanicus	H	55	80	Cloutier et al. 1985
Zn	Ontario	M.pennsylvanicus	H	60	5.5	Cloutier et al. 1985
Zn	GreatBritain	M.agrestis	H	113	61.9	Andrews et al. 1989a
Zn	Pennsylvania	M.pennsylvanicus	H	83.27	23.41	Alberici et al. 1989
Zn	Ohio	M.pennsylvanicus	H	74.15625	36.84	Tighlman-Hall et al. 1990
Zn	GreatBritain	M.agrestis	H	120	0	Beardsley et al. 1978
Zn	Ohio	M.pennsylvanicus	H	71.65625	36.84	Tighlman-Hall et al. 1990
Zn	Pennsylvania	S.floridanus	H	115	77.9	Dressler et al. 1986
Zn	Ohio	M.pennsylvanicus	H	71.09375	90.25	Tighlman-Hall et al. 1990
Zn	GreatBritain	M.agrestis	H	120	1925	Andrews et al. 1989a
Zn	BritishColumbia	P.maniculatus	O	79.5	89	Laurinolli and Bendell-Young 1996
Zn	BritishColumbia	P.maniculatus	O	100	84	Laurinolli and Bendell-Young 1996
Zn	Montana	P.maniculatus	O	84.0625	1908.9	Pascoe et al. 1994, 1996
Zn	BritishColumbia	P.maniculatus	O	90.3	59	Laurinolli and Bendell-Young 1996

TABLE E-2

Summary of Literature-derived Soil Small Mammal Kidney Bioaccumulation Data

Analyte	Study Location	Species	Trophic Group	Mean Tissue Conc mg/kg dry wt	Soil Conc mg/kg dry wt	Reference
Cd	GreatBritain	S_araneus	C	25.7	0.75	Hunter and Johnson 1982
Cd	GreatBritain	S_araneus_imm	C	10.28	3.3	Read and Martin 1993
Cd	GreatBritain	S_minutus_ad	C	49.9	19.9	Read and Martin 1993
Cd	GreatBritain	S_araneus_ad	C	37	1	Read and Martin 1993
Cd	GreatBritain	S_araneus_imm	C	19.81	1.7	Read and Martin 1993
Cd	GreatBritain	S_araneus_imm	C	6.67	0.6	Read and Martin 1993
Cd	GreatBritain	S_araneus_imm	C	7.66	2	Read and Martin 1993
Cd	GreatBritain	S_minutus_imm	C	5.47	0.6	Read and Martin 1993
Cd	GreatBritain	S_minutus_imm	C	4.15	1.7	Read and Martin 1993
Cd	GreatBritain	S_minutus_ad	C	5.92	1	Read and Martin 1993
Cd	GreatBritain	S_araneus	C	158.1	0	Andrews et al. 1984
Cd	GreatBritain	S_minutus_imm	C	9.27	3.3	Read and Martin 1993
Cd	GreatBritain	S_araneus_ad	C	10.88	0.6	Read and Martin 1993
Cd	GreatBritain	S_araneus	C	193	8.5	Hunter and Johnson 1982
Cd	GreatBritain	S_araneus_imm	C	3.62	1	Read and Martin 1993
Cd	GreatBritain	S_minutus_ad	C	18.7	3.3	Read and Martin 1993
Cd	GreatBritain	S_minutus_imm	C	15.85	19.9	Read and Martin 1993
Cd	GreatBritain	S_araneus_ad	C	142.3	19.9	Read and Martin 1993
Cd	GreatBritain	S_minutus_ad	C	7.91	0.6	Read and Martin 1993
Cd	GreatBritain	S_minutus_ad	C	7.95	2	Read and Martin 1993
Cd	GreatBritain	S_minutus_imm	C	1.99	1	Read and Martin 1993
Cd	GreatBritain	S_araneus	C	139.4	3.1	Hunter and Johnson 1982
Cd	GreatBritain	S_araneus_imm	C	86.7	19.9	Read and Martin 1993
Cd	GreatBritain	S_araneus	C	4.13	0	Andrews et al. 1984
Cd	GreatBritain	S_araneus_ad	C	9.28	2	Read and Martin 1993
Cd	GreatBritain	S_minutus_ad	C	12.14	1.7	Read and Martin 1993
Cd	GreatBritain	S_araneus_ad	C	154.2	3.3	Read and Martin 1993
Cd	GreatBritain	S_minutus_imm	C	2.46	2	Read and Martin 1993
Cd	GreatBritain	S_araneus_ad	C	41.3	1.7	Read and Martin 1993
Cd	GreatBritain	M_agrestis	H	0.82	1.55	Johnson et al. 1978
Cd	Pennsylvania	S_floridanus	H	9.6	0.1	Dressler et al. 1986
Cd	Ohio	M_pennsylvanicus	H	0.00284375	2.28	Tighlman-Hall et al. 1990
Cd	GreatBritain	A_sylvaticus	H	10.30	11.2	Johnson et al. 1978
Cd	Pennsylvania	M_pennsylvanicus	H	0.48	0.06	Alberici et al. 1989
Cd	GreatBritain	A_sylvaticus	H	1.67	1.55	Johnson et al. 1978
Cd	GreatBritain	A_sylvaticus	H	1.68	1.44	Johnson et al. 1978
Cd	GreatBritain	C_glareolus	H	16.8	11.2	Johnson et al. 1978
Cd	GreatBritain	M_agrestis	H	8	0	Beardsley et al. 1978
Cd	GreatBritain	A_sylvaticus	H	18	45.9	Johnson et al. 1978
Cd	GreatBritain	M_agrestis	H	23.3	8.5	Hunter and Johnson 1982
Cd	GreatBritain	M_agrestis	H	1.75	0	Andrews et al. 1984
Cd	GreatBritain	A_sylvaticus	H	5.51	3.1	Hunter and Johnson 1982
Cd	GreatBritain	A_sylvaticus	H	2.19	1.1	Johnson et al. 1978
Cd	GreatBritain	M_agrestis	H	5.21	0	Andrews et al. 1984
Cd	GreatBritain	A_sylvaticus	H	39.7	92.2	Johnson et al. 1978
Cd	Ohio	M_pennsylvanicus	H	0.00090625	0.06	Tighlman-Hall et al. 1990
Cd	GreatBritain	A_sylvaticus	H	1.46	0.75	Hunter and Johnson 1982
Cd	Montana	M_pennsylvanicus	H	2.1875	7.8	Pascoe et al. 1994, 1996
Cd	GreatBritain	M_agrestis	H	5	0	Beardsley et al. 1978
Cd	Ohio	M_pennsylvanicus	H	0.00059375	0.06	Tighlman-Hall et al. 1990
Cd	Pennsylvania	S_floridanus	H	17	0.4	Dressler et al. 1986
Cd	GreatBritain	A_sylvaticus	H	7.4	8.5	Hunter and Johnson 1982
Cd	Pennsylvania	M_pennsylvanicus	H	1.41	0.09	Alberici et al. 1989
Cd	GreatBritain	M_agrestis	H	4.06	3.1	Hunter and Johnson 1982
Cd	GreatBritain	C_glareolus	H	4.58	1.55	Johnson et al. 1978
Cd	Ohio	M_pennsylvanicus	H	0.001875	2.28	Tighlman-Hall et al. 1990
Cd	GreatBritain	M_agrestis	H	1.3	0.75	Hunter and Johnson 1982
Cd	GreatBritain	M_agrestis	H	8.91	11.2	Johnson et al. 1978
Cd	Montana	P_maniculatus	O	3.4375	7.8	Pascoe et al. 1994, 1996
Cd	BritishColumbia	P_maniculatus	O	0.2	5.62	Laurinolli and Bendell-Young 1996
Cd	BritishColumbia	P_maniculatus	O	0.15	0.68	Laurinolli and Bendell-Young 1996

TABLE E-2

Summary of Literature-derived Soil Small Mammal Kidney Bioaccumulation Data

Analyte	Study Location	Species	Trophic Group	Mean Tissue Conc mg/kg dry wt	Soil Conc mg/kg dry wt	Reference
Cd	BritishColumbia	P_maniculatus	O	0.38	5.02	Laurinolli and Bendell-Young 1996
Co	Pennsylvania	M_pennsylvanicus	H	0.72	1.37	Alberici et al. 1989
Co	Pennsylvania	M_pennsylvanicus	H	0.77	0.15	Alberici et al. 1989
Co	Pennsylvania	S_floridanus	H	0.1	1	Dressler et al. 1986
Cr	Pennsylvania	M_pennsylvanicus	H	0.51	0.91	Alberici et al. 1989
Cr	GreatBritain	M_agrestis	H	0.5	0	Beardsley et al. 1978
Cr	GreatBritain	M_agrestis	H	1.1	0	Beardsley et al. 1978
Cr	Pennsylvania	M_pennsylvanicus	H	0.68	0.24	Alberici et al. 1989
Cu	GreatBritain	S_minutus_imm	C	9.12	12	Read and Martin 1993
Cu	GreatBritain	S_minutus_ad	C	9.56	12	Read and Martin 1993
Cu	GreatBritain	S_araneus_imm	C	19.27	151	Read and Martin 1993
Cu	GreatBritain	S_araneus_imm	C	6.73	14	Read and Martin 1993
Cu	GreatBritain	S_araneus_ad	C	9.79	14	Read and Martin 1993
Cu	GreatBritain	S_araneus_ad	C	10.83	18	Read and Martin 1993
Cu	GreatBritain	S_minutus_ad	C	4.77	14	Read and Martin 1993
Cu	GreatBritain	S_minutus_imm	C	7.76	14	Read and Martin 1993
Cu	GreatBritain	S_araneus_imm	C	2.96	24	Read and Martin 1993
Cu	GreatBritain	S_minutus_ad	C	16.78	18	Read and Martin 1993
Cu	GreatBritain	S_araneus_ad	C	8.8	12	Read and Martin 1993
Cu	GreatBritain	S_araneus_imm	C	60.5	18	Read and Martin 1993
Cu	GreatBritain	S_araneus_ad	C	7.76	18	Read and Martin 1993
Cu	GreatBritain	S_minutus_imm	C	18.2	151	Read and Martin 1993
Cu	GreatBritain	S_minutus_imm	C	2.87	24	Read and Martin 1993
Cu	GreatBritain	S_araneus_ad	C	16.65	151	Read and Martin 1993
Cu	GreatBritain	S_minutus_ad	C	4.95	24	Read and Martin 1993
Cu	GreatBritain	S_araneus_ad	C	13.9	24	Read and Martin 1993
Cu	GreatBritain	S_araneus_imm	C	10.92	18	Read and Martin 1993
Cu	GreatBritain	S_minutus_ad	C	14.03	151	Read and Martin 1993
Cu	GreatBritain	S_araneus_imm	C	6.52	12	Read and Martin 1993
Cu	GreatBritain	S_minutus_ad	C	3.77	18	Read and Martin 1993
Cu	GreatBritain	S_minutus_imm	C	13	18	Read and Martin 1993
Cu	GreatBritain	S_minutus_imm	C	17.8	18	Read and Martin 1993
Cu	GreatBritain	S_araneus	C	38.5	2480	Hunter and Johnson 1982
Cu	GreatBritain	S_araneus	C	22.8	9.3	Hunter and Johnson 1982
Cu	GreatBritain	S_araneus	C	30.8	246	Hunter and Johnson 1982
Cu	GreatBritain	M_agrestis	H	22.6	2480	Hunter and Johnson 1982
Cu	Montana	M_pennsylvanicus	H	15.9375	532.2	Pascoe et al. 1994, 1996
Cu	GreatBritain	M_agrestis	H	13	246	Hunter and Johnson 1982
Cu	Ohio	M_pennsylvanicus	H	10.3125	5.33	Tighlman-Hall et al. 1990
Cu	Ohio	M_pennsylvanicus	H	10.0625	24.19	Tighlman-Hall et al. 1990
Cu	Ontario	M_pennsylvanicus	H	17.5	38	Cloutier et al. 1985
Cu	GreatBritain	M_agrestis	H	21	0	Beardsley et al. 1978
Cu	Ohio	M_pennsylvanicus	H	9.875	5.33	Tighlman-Hall et al. 1990
Cu	Pennsylvania	S_floridanus	H	10.6	2.9	Dressler et al. 1986
Cu	GreatBritain	M_agrestis	H	33	0	Beardsley et al. 1978
Cu	GreatBritain	A_sylvaticus	H	11.7	246	Hunter and Johnson 1982
Cu	Pennsylvania	M_pennsylvanicus	H	12.29	2.47	Alberici et al. 1989
Cu	GreatBritain	A_sylvaticus	H	11.9	2480	Hunter and Johnson 1982
Cu	Pennsylvania	S_floridanus	H	10.9	6.7	Dressler et al. 1986
Cu	Ontario	M_pennsylvanicus	H	24.5	30	Cloutier et al. 1985
Cu	GreatBritain	M_agrestis	H	10.8	9.3	Hunter and Johnson 1982
Cu	Ohio	M_pennsylvanicus	H	10.8125	24.19	Tighlman-Hall et al. 1990
Cu	GreatBritain	A_sylvaticus	H	13.5	9.3	Hunter and Johnson 1982
Cu	Ontario	M_pennsylvanicus	H	20	400	Cloutier et al. 1985
Cu	Pennsylvania	M_pennsylvanicus	H	11.7	2.92	Alberici et al. 1989
Cu	BritishColumbia	P_maniculatus	O	2.67	252.9	Laurinolli and Bendell-Young 1996
Cu	BritishColumbia	P_maniculatus	O	3.96	293	Laurinolli and Bendell-Young 1996
Cu	Montana	P_maniculatus	O	17.8125	532.2	Pascoe et al. 1994, 1996
Cu	BritishColumbia	P_maniculatus	O	2.54	63.4	Laurinolli and Bendell-Young 1996
F	GreatBritain	S_araneus	C	14.9	98876	Andrews et al. 1989b
F	GreatBritain	S_araneus	C	11.3	131.2	Andrews et al. 1989b

TABLE E-2

Summary of Literature-derived Soil Small Mammal Kidney Bioaccumulation Data

Analyte	Study Location	Species	Trophic Group	Mean Tissue Conc mg/kg dry wt	Soil Conc mg/kg dry wt	Reference
F	GreatBritain	M_agrestis	H	15.1	98876	Andrews et al. 1989b
F	GreatBritain	M_agrestis	H	8.35	131.2	Andrews et al. 1989b
Fe	Ontario	M_pennsylvanicus	H	250	22000	Cloutier et al. 1985
Fe	Ontario	M_pennsylvanicus	H	300	8000	Cloutier et al. 1985
Fe	Ontario	M_pennsylvanicus	H	650	100000	Cloutier et al. 1985
Hg	Tennessee	B_brevicauda	C	121.25	269	Talmage and Walton 1993
Hg	Tennessee	B_brevicauda	C	2.96875	0.21	Talmage and Walton 1993
Hg	GreatBritain	A_sylvaticus	H	0.375	0.106	Bull et al. 1977
Hg	GreatBritain	C_glareolus	H	1.09375	3.81	Bull et al. 1977
Hg	GreatBritain	C_glareolus	H	0.25	0.106	Bull et al. 1977
Hg	GreatBritain	A_sylvaticus	H	1.625	3.81	Bull et al. 1977
Hg	Tennessee	P_leucopus	O	1.5625	0.21	Talmage and Walton 1993
Hg	Tennessee	P_leucopus	O	3.625	269	Talmage and Walton 1993
Mn	GreatBritain	M_agrestis	H	7	0	Beardsley et al. 1978
Mn	GreatBritain	M_agrestis	H	6	0	Beardsley et al. 1978
Ni	Pennsylvania	M_pennsylvanicus	H	0.29	0.77	Alberici et al. 1989
Ni	Pennsylvania	M_pennsylvanicus	H	1.01	2.21	Alberici et al. 1989
Ni	Pennsylvania	S_floridanus	H	0.5	2.2	Dressler et al. 1986
Ni	Pennsylvania	S_floridanus	H	0.8	3.1	Dressler et al. 1986
Pb	GreatBritain	S_araneus_ad	C	19.3	125	Read and Martin 1993
Pb	GreatBritain	S_araneus_imm	C	38.7	1142	Read and Martin 1993
Pb	GreatBritain	S_minutus_ad	C	2.1	50	Read and Martin 1993
Pb	GreatBritain	S_araneus_ad	C	9.7	50	Read and Martin 1993
Pb	NewJersey	B_brevicauda	C	1.45	74	Stansley and Roscoe 1996
Pb	GreatBritain	S_araneus_imm	C	5.2	98	Read and Martin 1993
Pb	GreatBritain	S_minutus_imm	C	5.5	138	Read and Martin 1993
Pb	GreatBritain	S_minutus_imm	C	3.8	125	Read and Martin 1993
Pb	GreatBritain	S_araneus_ad	C	20.1	138	Read and Martin 1993
Pb	GreatBritain	S_araneus_ad	C	380	1142	Read and Martin 1993
Pb	GreatBritain	S_araneus_imm	C	13.3	125	Read and Martin 1993
Pb	GreatBritain	S_araneus	C	45.7	0	Chmiel and Harrison 1981
Pb	GreatBritain	S_minutus_imm	C	2.3	33	Read and Martin 1993
Pb	GreatBritain	S_minutus_imm	C	2.6	50	Read and Martin 1993
Pb	GreatBritain	S_minutus_ad	C	6.8	138	Read and Martin 1993
Pb	GreatBritain	S_araneus_imm	C	3	50	Read and Martin 1993
Pb	GreatBritain	S_minutus_ad	C	4.9	98	Read and Martin 1993
Pb	GreatBritain	S_minutus_ad	C	51	1142	Read and Martin 1993
Pb	GreatBritain	S_minutus_imm	C	12.4	1142	Read and Martin 1993
Pb	GreatBritain	S_minutus_ad	C	42	33	Read and Martin 1993
Pb	GreatBritain	S_araneus_ad	C	1.9	98	Read and Martin 1993
Pb	GreatBritain	S_araneus	C	8.6	0	Chmiel and Harrison 1981
Pb	GreatBritain	S_araneus_imm	C	2.2	33	Read and Martin 1993
Pb	NewJersey	B_brevicauda	C	1506	75000	Stansley and Roscoe 1996
Pb	GreatBritain	S_araneus_ad	C	1.8	33	Read and Martin 1993
Pb	GreatBritain	S_minutus_imm	C	5.3	98	Read and Martin 1993
Pb	GreatBritain	S_araneus_imm	C	5.5	138	Read and Martin 1993
Pb	GreatBritain	S_minutus_ad	C	3.9	125	Read and Martin 1993
Pb	Ohio	M_pennsylvanicus	H	2.8125	19.32	Tighlman-Hall et al. 1990
Pb	NewYork	M_pennsylvanicus	H	41	6326	Haschek et al. 1979
Pb	Ohio	M_pennsylvanicus	H	2.125	19.32	Tighlman-Hall et al. 1990
Pb	GreatBritain	C_glareolus	H	8.5	78	Johnson et al. 1978
Pb	Pennsylvania	S_floridanus	H	2.3	3.5	Dressler et al. 1986
Pb	GreatBritain	A_sylvaticus	H	65.2	4030	Johnson et al. 1978
Pb	GreatBritain	M_agrestis	H	7	0	Beardsley et al. 1978
Pb	GreatBritain	A_sylvaticus	H	14.1	76.1	Johnson et al. 1978
Pb	GreatBritain	A_sylvaticus	H	46.6	8430	Johnson et al. 1978
Pb	GreatBritain	A_sylvaticus	H	12.7	96.3	Johnson et al. 1978
Pb	NewYork	M_pinetorum	H	27	6326	Haschek et al. 1979
Pb	GreatBritain	M_agrestis	H	8.26	78	Johnson et al. 1978
Pb	GreatBritain	A_sylvaticus	H	39.2	14010	Johnson et al. 1978
Pb	Ohio	M_pennsylvanicus	H	3.28125	43.48	Tighlman-Hall et al. 1990

TABLE E-2

Summary of Literature-derived Soil Small Mammal Kidney Bioaccumulation Data

Analyte	Study Location	Species	Trophic Group	Mean Tissue Conc mg/kg dry wt	Soil Conc mg/kg dry wt	Reference
Pb	GreatBritain	C_glareolus	H	46.5	14010	Johnson et al. 1978
Pb	Ohio	M_pennsylvanicus	H	2.8125	43.48	Tighlman-Hall et al. 1990
Pb	GreatBritain	M_agrestis	H	60.4	14010	Johnson et al. 1978
Pb	Pennsylvania	M_pennsylvanicus	H	1.06	2.67	Alberici et al. 1989
Pb	Pennsylvania	S_floridanus	H	1.5	2.7	Dressler et al. 1986
Pb	NewYork	M_pennsylvanicus	H	18.7	1342	Haschek et al. 1979
Pb	NewYork	M_pennsylvanicus	H	3.3	14.2	Haschek et al. 1979
Pb	GreatBritain	C_glareolus	H	12.1	0	Chmiel and Harrison 1981
Pb	Pennsylvania	M_pennsylvanicus	H	2.27	0.88	Alberici et al. 1989
Pb	GreatBritain	A_sylvaticus	H	9.8	0	Chmiel and Harrison 1981
Pb	NewYork	M_pennsylvanicus	H	7.2	14.2	Haschek et al. 1979
Pb	NewYork	M_pennsylvanicus	H	2	14.2	Haschek et al. 1979
Pb	NewYork	M_pennsylvanicus	H	34	6326	Haschek et al. 1979
Pb	NewYork	M_pennsylvanicus	H	14.2	1342	Haschek et al. 1979
Pb	NewYork	M_pennsylvanicus	H	3.9	14.2	Haschek et al. 1979
Pb	GreatBritain	M_agrestis	H	6	0	Beardsley et al. 1978
Pb	NewYork	M_pennsylvanicus	H	21	1342	Haschek et al. 1979
Pb	NewYork	M_pennsylvanicus	H	24	1342	Haschek et al. 1979
Pb	NewYork	M_pinetorum	H	30	6326	Haschek et al. 1979
Pb	NewYork	M_pennsylvanicus	H	23	1342	Haschek et al. 1979
Pb	GreatBritain	A_sylvaticus	H	9.4	78	Johnson et al. 1978
Pb	NewYork	P_leucopus	O	14.6	6326	Haschek et al. 1979
Pb	NewJersey	P_leucopus	O	34.9	75000	Stansley and Roscoe 1996
Pb	Kansas	P_maniculatus	O	1.92	14	Kisseberth et al. 1984
Pb	Kansas	P_maniculatus	O	12.48	62	Kisseberth et al. 1984
Pb	Colorado	P_maniculatus	O	3.28	26.6	Mierau and Favara 1975
Pb	Colorado	P_maniculatus	O	8.46	73	Mierau and Favara 1975
Pb	NewYork	P_leucopus	O	9.7	6326	Haschek et al. 1979
Pb	Kansas	P_maniculatus	O	23.66	38	Kisseberth et al. 1984
Pb	Kansas	P_maniculatus	O	1.38	19	Kisseberth et al. 1984
Pb	Kansas	P_maniculatus	O	3.12	8	Kisseberth et al. 1984
Pb	Kansas	P_maniculatus	O	2.78	18	Kisseberth et al. 1984
Pb	NewJersey	P_leucopus	O	2.42	74	Stansley and Roscoe 1996
Pb	Kansas	P_maniculatus	O	1.92	19	Kisseberth et al. 1984
Pb	Kansas	P_maniculatus	O	11	24	Kisseberth et al. 1984
Pb	Kansas	P_maniculatus	O	1.43	38	Kisseberth et al. 1984
Pb	Kansas	P_maniculatus	O	1.81	12	Kisseberth et al. 1984
Zn	GreatBritain	S_minutus_ad	C	95	193	Read and Martin 1993
Zn	GreatBritain	S_minutus_ad	C	109	159	Read and Martin 1993
Zn	GreatBritain	S_araneus_ad	C	201	1389	Read and Martin 1993
Zn	GreatBritain	S_minutus_imm	C	102	193	Read and Martin 1993
Zn	GreatBritain	S_minutus_ad	C	78	74	Read and Martin 1993
Zn	GreatBritain	S_minutus_imm	C	98	159	Read and Martin 1993
Zn	GreatBritain	S_minutus_ad	C	74	257	Read and Martin 1993
Zn	GreatBritain	S_araneus_ad	C	77	74	Read and Martin 1993
Zn	GreatBritain	S_araneus_imm	C	143	1389	Read and Martin 1993
Zn	GreatBritain	S_minutus_imm	C	136	74	Read and Martin 1993
Zn	GreatBritain	S_minutus_imm	C	30	112	Read and Martin 1993
Zn	GreatBritain	S_araneus_imm	C	54	112	Read and Martin 1993
Zn	GreatBritain	S_araneus_imm	C	108	159	Read and Martin 1993
Zn	GreatBritain	S_minutus_imm	C	78	1389	Read and Martin 1993
Zn	GreatBritain	S_araneus_ad	C	55	159	Read and Martin 1993
Zn	GreatBritain	S_minutus_imm	C	67	257	Read and Martin 1993
Zn	GreatBritain	S_minutus_ad	C	72	112	Read and Martin 1993
Zn	GreatBritain	S_araneus_ad	C	123	193	Read and Martin 1993
Zn	GreatBritain	S_araneus_imm	C	156	193	Read and Martin 1993
Zn	GreatBritain	S_araneus_ad	C	137	112	Read and Martin 1993
Zn	GreatBritain	S_araneus_ad	C	109	257	Read and Martin 1993
Zn	GreatBritain	S_araneus_imm	C	47	257	Read and Martin 1993
Zn	GreatBritain	S_araneus_imm	C	59	74	Read and Martin 1993
Zn	GreatBritain	S_minutus_ad	C	153	1389	Read and Martin 1993

TABLE E-2

Summary of Literature-derived Soil Small Mammal Kidney Bioaccumulation Data

Analyte	Study Location	Species	Trophic Group	Mean Tissue Conc mg/kg dry wt	Soil Conc mg/kg dry wt	Reference
Zn	GreatBritain	S_araneus	C	281	1925	Andrews et al. 1989a
Zn	GreatBritain	S_araneus	C	204	61.9	Andrews et al. 1989a
Zn	Ohio	M_pennsylvanicus	H	72.28125	90.25	Tighlman-Hall et al. 1990
Zn	Ohio	M_pennsylvanicus	H	89.1875	36.84	Tighlman-Hall et al. 1990
Zn	Ontario	M_pennsylvanicus	H	65	5.5	Cloutier et al. 1985
Zn	Pennsylvania	M_pennsylvanicus	H	55.07	1.5	Alberici et al. 1989
Zn	Ontario	M_pennsylvanicus	H	70	90	Cloutier et al. 1985
Zn	GreatBritain	M_agrestis	H	108	0	Beardsley et al. 1978
Zn	Pennsylvania	S_floridanus	H	87.5	77.9	Dressler et al. 1986
Zn	Ohio	M_pennsylvanicus	H	68.875	90.25	Tighlman-Hall et al. 1990
Zn	GreatBritain	M_agrestis	H	121	61.9	Andrews et al. 1989a
Zn	Ontario	M_pennsylvanicus	H	78	80	Cloutier et al. 1985
Zn	Pennsylvania	M_pennsylvanicus	H	59.32	23.41	Alberici et al. 1989
Zn	Montana	M_pennsylvanicus	H	104.375	1908.9	Pascoe et al. 1994, 1996
Zn	Pennsylvania	S_floridanus	H	81.6	1.5	Dressler et al. 1986
Zn	GreatBritain	M_agrestis	H	123	1925	Andrews et al. 1989a
Zn	GreatBritain	A_sylvaticus	H	158	131	Johnson et al. 1978
Zn	GreatBritain	M_agrestis	H	104	0	Beardsley et al. 1978
Zn	GreatBritain	A_sylvaticus	H	101	21000	Johnson et al. 1978
Zn	Ohio	M_pennsylvanicus	H	70.9375	36.84	Tighlman-Hall et al. 1990
Zn	BritishColumbia	P_maniculatus	O	15.9	84	Laurinolli and Bendell-Young 1996
Zn	BritishColumbia	P_maniculatus	O	14.8	59	Laurinolli and Bendell-Young 1996
Zn	Montana	P_maniculatus	O	115.9375	1908.9	Pascoe et al. 1994, 1996
Zn	BritishColumbia	P_maniculatus	O	15.6	89	Laurinolli and Bendell-Young 1996

TABLE E-3

Summary of Soil-Liver Loglinear Regression Models for Small Mammals Based on Literature Data

Analyte	Type	N	Intercept	Slope	p (model)	rsquare
Arsenic	general	17	-0.24137	0.35117	0.27	0.08
Arsenic	omnivore	17	-0.24137	0.35117	0.27	0.08
Cadmium	general	73	0.32081	0.89989	0.0001	0.22
Cadmium	herbivore	25	-1.49682	0.84079	0.006	0.29
Cadmium	insectivore	27	2.42915	0.78707	0.0004	0.4
Copper	general	49	2.38278	0.12835	0.0005	0.23
Copper	herbivore	18	2.34832	0.0671	0.02	0.29
Copper	insectivore	27	2.14592	0.23953	0.0004	0.4
Copper	omnivore	4	2.41303	0.15867	0.73	0.07
Lead	general	93	-0.41167	0.30209	0.0001	0.5
Lead	herbivore	34	-0.20656	0.28003	0.0001	0.69
Lead	insectivore	26	-1.3655	0.51792	0.0001	0.61
Lead	omnivore	33	-0.19344	0.21596	0.0014	0.28
Mercury	general	8	0.64896	0.36749	0.54	0.07
Mercury	herbivore	5	-0.53257	0.37069	0.39	0.25
Mercury	omnivore	3	2.45081	0	.	.
Zinc	general	46	4.32514	0.05434	0.06	0.08
Zinc	herbivore	16	4.36384	0.01724	0.54	0.03
Zinc	insectivore	26	4.05449	0.12198	0.08	0.12
Zinc	omnivore	4	4.58473	-0.0206	0.66	0.11

TABLE E-4

Summary of Soil-Kidney Loglinear Regression Models for Small Mammals Based on Literature Data

Analyte	Type	N	Intercept	Slope	p (model)	rsquare
Cadmium	general	56	0.77205	0.83163	0.0002	0.23
Cadmium	insectivore	27	2.21295	0.69078	0.001	0.35
Cadmium	herbivore	25	-0.24265	0.84205	0.007	0.28
Cadmium	omnivore	4	-1.82495	0.81074	0.37	0.4
Copper	general	49	2.0674	0.08982	0.1	0.06
Copper	insectivore	27	1.46091	0.2749	0.01	0.23
Copper	herbivore	18	2.3482	0.06439	0.03	0.27
Lead	general	73	-0.08331	0.43483	0.0001	0.63
Lead	insectivore	26	-1.93149	0.81941	0.0001	0.68
Lead	herbivore	31	0.21701	0.39004	0.0001	0.9
Lead	omnivore	16	0.40252	0.26832	0.004	0.46
Mercury	general	8	0.38825	0.43521	0.03	0.58
Zinc	general	46	3.79102	0.12375	0.015	0.13
Zinc	insectivore	26	3.47906	0.20313	0.03	0.17
Zinc	herbivore	16	4.1514	0.06534	0.02	0.32
Zinc	omnivore	4	0.05443	0.62009	0.004	0.99