

## **APPENDIX 2: UPDATED TOXICITY DATABASES**











































































Appendix 2 Table 4.2: Updated diazinon chronic toxicity database

Species	Common name	Test <sup>a</sup>	Durration	pH	NOEC	LOEC	Chronic value (µg total daizinon/L)	SMCV	Reference
<i>Brachionus calyciflorus</i>	rotifer	LC	48hr	7.5	8000	31000	15,748	<b>15,748</b>	Snell 1992
<i>Ceriodaphnia dubia</i>	cladocern	LC	7d	--	0.22	0.52	0.34	<b>0.34</b>	Norberg-King 1987
<i>Daphnia magna</i>	cladocern	LC	21d	7.9	0	0.15	< 0.15		Fernandez et al. 1995
<i>Daphnia magna</i>	cladocern	LC	21d	7.9	0.15	0.18	0.17		Fernandez et al. 1995
<i>Daphnia magna</i>	cladocern	LC	21d	(7.7-8.1)	0	0.05	< 0.05		Sanches et al. 2000
<i>Daphnia magna</i>	cladocern	LC	21d	8.1	0.17	0.32	0.23	<b>0.12</b>	Suprenant 1988
<i>Brachydanio rerio</i>	zebrafish	ELS	42d	7.4	200	--	> 200	<b>&gt;200</b>	Bresh 1991
<i>Clarias batrachus</i>	walking catfish	PLC	40d	7.3	--	--	2,418.6 <sup>b</sup>	<b>2,418.6</b>	Tripathi et al. 1992
<i>Jordanella floridae</i>	flagfish	LC	--	--	0	14	< 14.00	<b>&lt;14.00</b>	Allison 1977
<i>Lepomis macrochirus</i>	bluegill	M	84d	(8.5-9.0)	9.2	22	14.23	<b>14.23</b>	Giddings et al. 1996
<i>Pimephales promelas</i>	fathead minnow	PLC	247d	--	28	60.3	41.09		Allison and Hermanutz 1977
<i>Pimephales promelas</i>	fathead minnow	ELS	32d	(7.4-7.8)	50	90	67.08		Jarvinen and Tanner 1982
<i>Pimephales promelas</i>	fathead minnow	ELS	32d	--	16.5	37.8	24.97		Norberg-King 1987
<i>Pimephales promelas</i>	fathead minnow	ELS	34d	7.3	92	170	125.00	<b>54.16</b>	Suprenant 1988
<i>Salvelinus fontinalis</i>	brook trout	PLC	122d	--	0	0.8	< 0.80	<b>&lt;0.80</b>	Allison and Hermanutz 1977

<sup>a</sup>ELS=early life-stage, PLC=partial life cycle, LC=life cycle, M = micocosm

<sup>b</sup>LC<sub>50</sub> value

Appendix 2 Table 5.1: Updated zinc acute toxicity database

Species	Common name	Method <sup>a</sup>	Chemical	Hardness (mg/L as CaCO <sub>3</sub> )	Acute value (ug total Zn/L)	Adjusted acute value* (ug total Zn/L)	SMAV Reference	Slope?
<i>Aeolosoma headleyi</i>	Worm	--	--	45	18,100	19,803	<b>17,362</b> Cairns <i>et al.</i> 1978	
<i>Aeolosoma headleyi</i>	Worm	--	--	45	17,600	19,256	Cairns <i>et al.</i> 1978	
<i>Aeolosoma headleyi</i>	Worm	--	--	45	15,600	17,068	Cairns <i>et al.</i> 1978	
<i>Aeolosoma headleyi</i>	Worm	--	--	45	15,000	16,412	Cairns <i>et al.</i> 1978	
<i>Aeolosoma headleyi</i>	Worm	--	--	45	13,500	14,771	Cairns <i>et al.</i> 1978	
<i>Amnicola</i> sp. (adult)	Snail (adult)	S, M	--	50	14,000	14,000	<b>16,817</b> Rehwoldt <i>et al.</i> 1973**	
<i>Amnicola</i> sp. (embryo)	Snail (embryo)	S, M	--	50	20,200	20,200	Rehwoldt <i>et al.</i> 1973**	
<i>Anodonta imbecilis</i>	Freshwater mussel	S,M,T	Zinc sulfate	39	268	331	<b>296</b> Keller and Zam 1991	
<i>Anodonta imbecilis</i>	Freshwater mussel	S,M,T	Zinc sulfate	90	438	265	Keller and Zam 1991	
<i>Argia</i> sp.	Damselfly	S, U	Zinc sulfate	20	40,930	89,488	<b>89,488</b> Wurtz and Bridges 1961**	
<i>Asellus aquaticus</i>	Isopod	S, U	--	50	18,200	18,200	<b>18,200</b> Martin and Holdich 1986	
<i>Bryocamptus zschokkei</i> (nauplius)	Copepod	S,M,T	Zinc sulfate	100		509	Brown <i>et al.</i> 2005	
<i>Bryocamptus zschokkei</i> (copepodid)	Copepod	S,M,T	Zinc sulfate	100	920		<b>343</b> Brown <i>et al.</i> 2005	
<i>Bryocamptus zschokkei</i> (adult)	Copepod	S,M,T	Zinc sulfate	100	620	1,145	Brown <i>et al.</i> 2005	
<i>Caecidotea bicrenata</i>	Isopod (3-7 mm)	F, M	Zinc sulfate	220	20,110	5,677	<b>5,677</b> Bosnak and Morgan 1981**	
<i>Carcidotea communis</i>	Isopod	S, U	Zinc sulfate	20	12,734	27,841	<b>11,614</b> Wurtz and Bridges 1961**	
<i>Carcidotea communis</i>	Isopod	S, U	Zinc sulfate	100	8,755	4,845	Wurtz and Bridges 1961**	
<i>Ceriodaphnia dubia</i>	Cladoceran	R, M	Zinc chloride	52	180	174	<b>175</b> Carlson <i>et al.</i> 1986**	Y
<i>Ceriodaphnia dubia</i>	Cladoceran	S, M	Zinc bromide	190	500	160	Magliette <i>et al.</i> 1995	Y
<i>Ceriodaphnia dubia</i>	Cladoceran	S,M,D	--	44	413	461	Hyne <i>et al.</i> 2005	
<i>Ceriodaphnia dubia</i>	Cladoceran	S,M,D	--	44	200	223	Hyne <i>et al.</i> 2005	
<i>Ceriodaphnia dubia</i>	Cladoceran	S,M,D	--	44	539	601	Hyne <i>et al.</i> 2005	
<i>Ceriodaphnia dubia</i>	Cladoceran	S,M,D	--	44	518	578	Hyne <i>et al.</i> 2005	
<i>Ceriodaphnia dubia</i>	Cladoceran	S,M,D	--	44	155	173	Hyne <i>et al.</i> 2005	
<i>Ceriodaphnia dubia</i>	Cladoceran	S,M,D	--	374	390	70	Hyne <i>et al.</i> 2005	
<i>Ceriodaphnia dubia</i>	Cladoceran	S,M,D	--	44	70	78	Hyne <i>et al.</i> 2005	
<i>Ceriodaphnia dubia</i>	Cladoceran	S,M,D	--	374	160	29	Hyne <i>et al.</i> 2005	
<i>Ceriodaphnia reticulata</i>	Cladoceran	S, U	--	45	76	83	<b>51</b> Mount and Norberg 1984	
<i>Ceriodaphnia reticulata</i>	Cladoceran	S, U	Zinc chloride	45	41	45	Carlson and Roush 1985**	
<i>Ceriodaphnia reticulata</i>	Cladoceran	S, M	Zinc chloride	45	32	35	Carlson and Roush 1985**	
<i>Chironomus</i> sp.	Midge	--	--	50	18,200	18,200	<b>18,200</b> Rehwoldt <i>et al.</i> 1973	

Appendix 2 Table 5.1: Updated zinc acute toxicity database

Species	Common name	Method <sup>a</sup>	Chemical	Hardness (mg/L as CaCO <sub>3</sub> )	Acute value (ug total Zn/L)	Adjusted acute value* (ug Zn/L)	SMAV Reference	Slope?
<i>Chironomus plumosus</i>	Midge	S, U	Zinc sulfate	80	32,600	21,825	<b>21,825</b> Fargasova 2003	
<i>Corbicula fluminea</i>	Asiatic clam (10-21 mm)	S, M	Zinc sulfate	64	6,040	4,892	<b>4,892</b> Cherry <i>et al.</i> 1980; Rodgers <i>et al.</i> 1980**	
<i>Crangonyx pseudogracilis</i>	Amphipod	R,U	Zinc sulfate	50	19,800	19,800	<b>19,800</b> Martin and Holdich 1986	
<i>Cypris</i> sp.	Ostracod	--	--	114	3,000	1,484	<b>1,484</b> Qureshi <i>et al.</i> 1980	
<i>Daphnia magna</i>	Cladoceran	R, M	--	300	1,100	238	<b>299</b> Berglund and Dave 1984***	Y
<i>Daphnia magna</i>	Cladoceran	S,M	Zinc sulfate	45	280	306	Cairns <i>et al.</i> 1978**	Y
<i>Daphnia magna</i>	Cladoceran	S,M	--	54	334	313	Chapman <i>et al.</i> Manuscript**	Y
<i>Daphnia magna</i>	Cladoceran	S,M	--	105	525	279	Chapman <i>et al.</i> Manuscript**	Y
<i>Daphnia magna</i>	Cladoceran	S,M	--	196	655	204	Chapman <i>et al.</i> Manuscript**	Y
<i>Daphnia magna</i>	Cladoceran	F,M	--	130	799	353	Attar and Maly 1982**	Y
<i>Daphnia magna</i>	Cladoceran	S,M	Zinc sulfate	46.1	259	278	Barata <i>et al.</i> 1998	Y
<i>Daphnia magna</i>	Cladoceran	S,M	Zinc sulfate	90.7	1,060	638	Barata <i>et al.</i> 1998	Y
<i>Daphnia magna</i>	Cladoceran	S,M	Zinc sulfate	179	962	324	Barata <i>et al.</i> 1998	Y
<i>Daphnia magna</i>	Cladoceran	S,M	Zinc sulfate	46.1	131	140	Barata <i>et al.</i> 1998	Y
<i>Daphnia magna</i>	Cladoceran	S,M	Zinc sulfate	90.7	457	275	Barata <i>et al.</i> 1998	Y
<i>Daphnia magna</i>	Cladoceran	S,M	Zinc sulfate	179	601	202	Barata <i>et al.</i> 1998	Y
<i>Daphnia magna</i>	Cladoceran	S,M	Zinc bromide	190	1,220	390	Magliette <i>et al.</i> 1995	Y
<i>Daphnia magna</i>	Cladoceran	S,M,T	--	170	1,831	644	Baird <i>et al.</i> 1991	
<i>Daphnia magna</i>	Cladoceran	S,M,T	--	170	756	266	Baird <i>et al.</i> 1991	
<i>Daphnia magna</i>	Cladoceran	S,M,T	--	170	745	262	Baird <i>et al.</i> 1991	
<i>Daphnia magna</i>	Cladoceran	S,M,T	--	170	862	303	Baird <i>et al.</i> 1991	
<i>Daphnia magna</i>	Cladoceran	S,M,T	--	170	986	347	Baird <i>et al.</i> 1991	
<i>Daphnia magna</i>	Cladoceran	S,M,T	--	170	798	281	Baird <i>et al.</i> 1991	
<i>Daphnia magna</i>	Cladoceran	S,U	Zinc chloride	45.3	100	109 <sup>T</sup>	Biesinger and Christensen 1972**	
<i>Daphnia magna</i>	Cladoceran	S,U	--	45	68	74 <sup>T</sup>	Mount and Norberg 1984	
<i>Daphnia pulex</i>	Cladoceran	S,M	--	45	500	547	<b>253</b> Cairns <i>et al.</i> 1978**	
<i>Daphnia pulex</i>	Cladoceran	S,U	--	45	107	117	Mount and Norberg 1984	
<i>Drunella grandis</i>	Mayfly	S, M	zinc sulfate	50.6	>1,560	>1,544	<b>&gt;1,264</b> CEC 2005	
<i>Drunella grandis</i>	Mayfly	S, M	zinc sulfate	54.2	>3,050	>2,847	CEC 2005	
<i>Drunella grandis</i>	Mayfly	S, M	zinc sulfate	172	>2,190	>763	CEC 2005	
<i>Drunella grandis</i>	Mayfly	S, M	zinc sulfate	175	>3,050	>1,047	CEC 2005	
<i>Drunella grandis</i>	Mayfly	S, M	zinc sulfate	260.7	>3,270	>799	CEC 2005	
<i>Drunella grandis</i>	Mayfly	S, M	zinc sulfate	277.7	>6,290	>1,455	CEC 2005	
<i>Echinogammarus tibaldii</i>	Amphipod	--	--	240	25,900	6,788	<b>6,788</b> Pantani <i>et al.</i> 1997	
<i>Gammarus italicus</i>	Amphipod	--	--	240	8,800	2,306	<b>2,306</b> Pantani <i>et al.</i> 1997	
<i>Gammarus</i> sp.	Amphipod	S, M	--	50	8,100	8,100	<b>8,100</b> Rehwoldt <i>et al.</i> 1973**	
<i>Girardia tigrina</i>	Flatworm	--	--	50	7,400	7,400	<b>7,004</b> See <i>et al.</i> 1994	
<i>Girardia tigrina</i>	Flatworm	--	--	40	5,480	6,630	See 1976	
<i>Haplodiptomus viduus</i>	Copepod	S,M	Zinc sulfate	37.6	500	638	<b>638</b> Sharma and Selverai 1994	
<i>Helisoma campanulatum</i>	Snail (adult)	S, U	Zinc sulfate	20	870	1,902	<b>1,579</b> Wurtz 1962**	

(@12.8°C)

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Species	Common name	Method <sup>a</sup>	Chemical	Hardness (mg/L as CaCO <sub>3</sub> )	Acute value (ug total Zn/L)	Adjusted acute value* (ug total Zn/L)	SMAV Reference	Slope?
<i>Helisoma campanulatum</i>	Snail (adult)	S, U	Zinc sulfate	20 (@22.8°C)	1,270	2,777	Wurtz 1962**	
<i>Helisoma campanulatum</i>	Snail (adult)	S, U	Zinc sulfate	100 (@12.8°C)	3,030	1,677	Wurtz 1962**	
<i>Helisoma campanulatum</i>	Snail (adult)	S, U	Zinc sulfate	100 (@22.8°C)	1,270	703	Wurtz 1962**	
<i>Hyalella azteca</i>	Amphipod	--	--	100	436	241	<b>241</b> Eisenhauer <i>et al.</i> 1999	
<i>Isoperla</i> sp.	Stonefly	S,U	Zinc sulfate	182.2	>27,000	8,952	<b>&gt;8,952</b> CEC 2005	
<i>Lepidostoma</i> sp.	Caddisfly	S, M	Zinc sulfate	62.1	>19,100	>15,874	<b>&gt;15,054</b> CEC 2005	
<i>Lepidostoma</i> sp.	Caddisfly	S, M	Zinc sulfate	189.4	>38,800	>12,446	CEC 2005	
<i>Lepidostoma</i> sp.	Caddisfly	S, M	Zinc sulfate	308.8	>81,700	>17,266	CEC 2005	
<i>Limnodrilus hoffmeisteri</i>	Tubificid worm	S, U	Zinc sulfate	100	>2,274	>1,258	<b>&gt;1258</b> Wurtz and Bridges 1961**	
<i>Lirceus alabamiae</i>	Isopod (3-7 mm)	F, M	Zinc sulfate	152	8,375	3,242	<b>3,242</b> Bosnak and Morgan 1981**	
<i>Lophopodella carteri</i>	Bryozoan	S, U	--	205 (190-220)	5,630	1,688	<b>1,688</b> Perdue and Wood 1980**	
<i>Lumbricius variegatus</i>	Worm	S, U	Zinc chloride	30	6,300	9,744	<b>9,744</b> Bailey and Liu 1980**	
<i>Mesocyclops hyalinus</i>	Copepod	S,M	Zinc sulfate	37.6	3,800	4,847	<b>4,847</b> Sharma and Selverai 1994	
<i>Moina irrasa</i>	Cladoceran	--	--	5	77	553	<b>667</b> Zou and Bu 1994**	
<i>Moina irrasa</i>	Cladoceran	--	--	5	153	1,089	Zou and Bu 1994**	
<i>Moina irrasa</i>	Cladoceran	--	--	5	205	1,466	Zou and Bu 1994**	
<i>Moina irrasa</i>	Cladoceran	--	--	5	50	357	Zou and Bu 1994**	
<i>Moina irrasa</i>	Cladoceran	--	--	5	93	663	Zou and Bu 1994**	
<i>Moina irrasa</i>	Cladoceran	--	--	5	59	423	Zou and Bu 1994**	
<i>Moina macrocopa</i>	Cladoceran	S,M	Zinc sulfate	37.6	120	153	<b>153</b> Sharma and Selverai 1994	
<i>Nais</i> sp.	Worm	S, M	--	50	18,400	18,400	<b>18,400</b> Rehwoldt <i>et al.</i> 1973**	
<i>Pectinatella magnifica</i>	Bryozoan	S, U	--	205 (190-220)	4,310	1,292	<b>1,292</b> Perdue and Wood 1980**	
<i>Physa gyrina</i>	Snail (adult)	F, M	Zinc chloride	36	1,274	1,686	<b>1,686</b> Nebeker <i>et al.</i> 1986**	
<i>Physa heterostropha</i>	Snail	S, U	Zinc chloride	45 (@20°C)	1,800	1,969	<b>1,087</b> Cairns and Scheler 1958b; Academy of Natural Sciences 1960**	Y
<i>Physa heterostropha</i>	Snail	S, U	Zinc chloride	45 (@30°C)	1,000	1,094	Cairns and Scheler 1958b; Academy of Natural Sciences 1960**	Y
<i>Physa heterostropha</i>	Snail	S, U	Zinc chloride	170 (@20°C)	6,200	2,181	Cairns and Scheler 1958b; Academy of Natural Sciences 1960**	Y
<i>Physa heterostropha</i>	Snail	S, U	Zinc chloride	170 (@30°C)	7,100	2,498	Cairns and Scheler 1958b; Academy of Natural Sciences 1960**	Y
<i>Physa heterostropha</i>	Snail (adult)	S, U	Zinc sulfate	20	1,110	2,427	Wurtz and Bridges 1961; Wurtz 1962**	Y
<i>Physa heterostropha</i>	Snail (adult)	S, U	Zinc sulfate	100	3,160	1,749	Wurtz and Bridges 1961; Wurtz 1962**	Y
<i>Physa heterostropha</i>	Snail (young)	S, U	Zinc sulfate	20 (@10.6°C)	303	662	Wurtz 1962**	Y

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<i>Physa heterostropha</i>	Snail (young)	S, U	Zinc sulfate	20	434	949	Wurtz 1962**	Y
<i>Physa heterostropha</i>				(@12.8°C)				
<i>Physa heterostropha</i>	Snail (young)	S, U	Zinc sulfate	20	350	765	Wurtz 1962**	Y
				(@32.2°C)				
<i>Physa heterostropha</i>	Snail (young)	S, U	Zinc sulfate	100	434	240	Wurtz 1962**	Y
				(@10.6°C)				
<i>Physa heterostropha</i>	Snail (young)	S, U	Zinc sulfate	100	1,390	769	Wurtz 1962**	Y
				(@12.8°C)				
<i>Physa heterostropha</i>	Snail (young)	S, U	Zinc sulfate	100	1,110	614	Wurtz 1962**	Y
				(@32.2°C)				
<i>Plumatella emarginata</i>	Bryozoa	S, U	--	205	5,300	1,589	<b>1,589</b> Perdue and Wood 1980**	
				(190-220)				
<i>Ranatra elongata</i>	Water scorpion	--	--	112.4	1,658	830	<b>830</b> Shukla <i>et al.</i> 1983	
<i>Stenocypris malcomsoni</i>	Ostracod	S, M	Zinc sulfate	37.6	3,500	4,464	<b>4,464</b> Sharma and Selverai 1994	
<i>Trichoptera</i>	Caddisfly	--	--	50	58,100	58,100	<b>58,100</b> Rehwoldt <i>et al.</i> 1973	
<i>Tropocyclops prasinus</i>	Copepod	S, U	Zinc chloride	10	52	205	<b>205</b> Lelande and Pinel-Alloul 1985	
<i>Tubifex tubifex</i>	Tubificid worm	--	--	224	130,000	36,137	<b>9,612</b> Qureshi <i>et al.</i> 1980	Y
<i>Tubifex tubifex</i>	Tubificid worm	--	--	34.2	2,570	3,554	Brkovic-Popovic and Popovic 1977	Y
<i>Tubifex tubifex</i>	Tubificid worm	--	--	261	60,200	14,687	Brkovic-Popovic and Popovic 1977	Y
<i>Tubifex tubifex</i>	Tubificid worm	--	--	0.1	110	22,157	Brkovic-Popovic and Popovic 1977	Y
<i>Tubifex tubifex</i>	Tubificid worm	--	--	34.2	2,980	4,121	Brkovic-Popovic and Popovic 1977	Y
<i>Tubifex tubifex</i>	Tubificid worm	R, U	Zinc sulfate	245	17,780	4,578	Khangarot 1991	
<i>Zygoptera</i>	Damselfly	--	--	50	26,200	26,200	<b>26,200</b> Rehwoldt <i>et al.</i> 1973	
<i>Agosia chrysogaster</i>	Longfin dace (juvenile)	R, M	Zinc sulfate	217	790	226	<b>226</b> Lewis 1978**	
<i>Anguilla rostrata</i>	American eel	S, M	--	55	14,500	13,367	<b>13,627</b> Rehwoldt <i>et al.</i> 1972**	
<i>Anguilla rostrata</i>	American eel	S, M	Zinc nitrate	53	14,600	13,892	Rehwoldt <i>et al.</i> 1973**	
<i>Carassius auratus</i>	Goldfish	S, U	Zinc sulfate	50	7,500	7,500	<b>10,276</b> Cairns <i>et al.</i> 1978**	
<i>Carassius auratus</i>	Goldfish (1-2 g)	S, U	Zinc sulfate	20	6,440	14,080	Pickering and Henderson 1966**	
<i>Catostomus commersoni</i>	White sucker (17.7 g)	F, M	Zinc chloride	18	2,200	5,263	<b>5,263</b> Duncam and Klaverkamp 1983**	
<i>Catostomus latipinnis</i>	Flannelmouth Sucker	--	--	144	1,480	600	<b>600</b> Hamilton and Buhl 1997	
<i>Cottus bairdi</i>	Mottled Sculpin	F, M	--	48.6	156	160	<b>182</b> Woodling <i>et al.</i> 2002	Y
<i>Cottus bairdi</i>	Mottled Sculpin	F, M	Zinc sulfate	154	439	168	Brinkman and Woodling 2005	Y
<i>Cottus bairdi</i>	Mottled Sculpin	F, M	Zinc sulfate	156	590	223	Brinkman and Woodling 2005	Y
<i>Cyprinus carpio</i>	Common carp (<20 cm)	S, M	Zinc nitrate	53	7,800	7,421	<b>7,245</b> Rehwoldt <i>et al.</i> 1971**	
<i>Cyprinus carpio</i>	Common carp	S, M	--	55	7,800	7,190	Rehwoldt <i>et al.</i> 1972**	
<i>Cyprinus carpio</i>	Common carp (2.1 g)	R, U	Zinc sulfate	19	3,120	7,127	Khangarot <i>et al.</i> 1983**	
<i>Fundulus diaphanus</i>	Banded killifish (<20 cm)	S, M	Zinc nitrate	53	19,100	18,173	<b>17,935</b> Rehwoldt <i>et al.</i> 1971**	
<i>Fundulus diaphanus</i>	Banded killifish	S, M	--	55	19,200	17,700	Rehwoldt <i>et al.</i> 1972**	
<i>Gambusia affinis (fries)</i>	Mosquitofish	S, U	--	50	50,000	50,000	<b>32,370</b> Kallanagoudar and Patil 1997	
<i>Gambusia affinis (fries)</i>	Mosquitofish	S, U	--	150	80,000	31,316	Kallanagoudar and Patil 1997	
<i>Gambusia affinis (fries)</i>	Mosquitofish	S, U	--	300	100,000	21,662	Kallanagoudar and Patil 1997	

Appendix 2 Table 5.1: Updated zinc acute toxicity database

Species	Common name	Method <sup>a</sup>	Chemical	Hardness (mg/L as CaCO <sub>3</sub> )	Acute value (ug total Zn/L)	Adjusted acute value* (ug Zn/L)	SMAV Reference	Slope?
<i>Gambusia affinis (male)</i>	Mosquitofish	S,U	--	50	115,000	115,000 <sup>†</sup>	Kallanagoudar and Patil 1997	
<i>Gambusia affinis (male)</i>	Mosquitofish	S,U	--	150	140,000	54,804 <sup>†</sup>	Kallanagoudar and Patil 1997	
<i>Gambusia affinis (male)</i>	Mosquitofish	S,U	--	300	150,000	32,493 <sup>†</sup>	Kallanagoudar and Patil 1997	
<i>Gambusia affinis (female)</i>	Mosquitofish	S,U	--	50	90,000	90,000 <sup>†</sup>	Kallanagoudar and Patil 1997	
<i>Gambusia affinis (female)</i>	Mosquitofish	S,U	--	150	120,000	46,975 <sup>†</sup>	Kallanagoudar and Patil 1997	
<i>Gambusia affinis (female)</i>	Mosquitofish	S,U	--	300	140,000	30,326 <sup>†</sup>	Kallanagoudar and Patil 1997	
<i>Gila elegans</i>	Bonytail (larvae)	S,U	Zinc chloride	199	5,350	1,645	<b>2,013</b> Buhl and Hamilton 1996	
<i>Gila elegans</i>	Bonytail (larvae)	S,U	Zinc chloride	199	8,010	2,463	Buhl and Hamilton 1996	
<i>Jordanella floridae</i>	Flagfish (juvenile)	F, M	Zinc sulfate	44	1,500	1,673	<b>1,673</b> Spehar 1976 a,b**	
<i>Lepomis gibbosus</i>	Pumpkinseed (<20 cm)	S, M	Zinc nitrate	53	20,000	19,029	<b>18,778</b> Rehwoldt <i>et al.</i> 1971**	
<i>Lepomis gibbosus</i>	Pumpkinseed	S, M	--	55	20,100	18,529	Rehwoldt <i>et al.</i> 1972**	
<i>Lepomis macrochirus</i>	Bluegill	F, M	Zinc sulfate	46	9,900	10,630	<b>5,290</b> Cairns <i>et al.</i> 1971**	Y
<i>Lepomis macrochirus</i>	Bluegill	F, M	Zinc sulfate	46	12,100	12,993	Cairns <i>et al.</i> 1971**	Y
<i>Lepomis macrochirus</i>	Bluegill (0.96 g)	F, M	Zinc chloride	45	3,573	3,909	Cairns and Scheler 1959**	Y
<i>Lepomis macrochirus</i>	Bluegill (2.80 g)	F, M	Zinc chloride	45	3,453	3,778	Cairns and Scheler 1959**	Y
<i>Lepomis macrochirus</i>	Bluegill (54.26 g)	F, M	Zinc chloride	45	3,314	3,626	Cairns and Scheler 1959**	Y
<i>Lepomis macrochirus</i>	Bluegill	F,M,T	Zinc sulfate	40.2	3,600	4,337	Thompson <i>et al.</i> 1980	Y
<i>Lepomis macrochirus</i>	Bluegill	F,M,T	Zinc sulfate	40.2	3,000	3,614	Thompson <i>et al.</i> 1980	Y
<i>Lepomis macrochirus</i>	Bluegill (3.5-3.9 g)	S, U	Zinc chloride	45	4,200	4,595	Cairns and Scheler 1957, 1968; Academy of Natural Sciences 1960**	Y
<i>Lepomis macrochirus</i>	Bluegill (3.5-3.9 g)	S, U	Zinc chloride	45 (@18°C)	3,500	3,829	Cairns and Scheler 1957; Academy of Natural Sciences 1960**	Y
<i>Lepomis macrochirus</i>	Bluegill (3.5-3.9 g)	S, U	Zinc chloride	170 (@30°C)	12,900	4,538	Cairns and Scheler 1957; Academy of Natural Sciences 1960**	Y
<i>Lepomis macrochirus</i>	Bluegill (3.5-3.9 g)	S, U	Zinc chloride	170 (@18°C)	12,500	4,397	Cairns and Scheler 1957; Academy of Natural Sciences 1960**	Y
<i>Lepomis macrochirus</i>	Bluegill (2.5-3.9 g)	S, U	Zinc chloride	45 (@30°C)	8,020	8,775	Cairns and Scheler 1958a; Academy of Natural Sciences 1960**	Y
<i>Lepomis macrochirus</i>	Bluegill (1-2 g)	S, U	Zinc sulfate	20 (@15°C)	6,440	14,080	Pickering and Henderson 1966**	Y
<i>Lepomis macrochirus</i>	Bluegill (1-2 g)	S, U	Zinc sulfate	20 (@25°C)	5,460	11,938	Pickering and Henderson 1966**	Y
<i>Lepomis macrochirus</i>	Bluegill (1-2 g)	S, U	Zinc sulfate	20 (@25°C)	4,850	10,604	Pickering and Henderson 1966**	Y
<i>Lepomis macrochirus</i>	Bluegill (1-2 g)	S, U	Zinc sulfate	20 (@25°C)	5,820	12,725	Pickering and Henderson 1966**	Y
<i>Lepomis macrochirus</i>	Bluegill (1-2 g)	S, U	Zinc chloride	20 (@25°C)	5,370	11,741	Pickering and Henderson 1966**	Y
<i>Lepomis macrochirus</i>	Bluegill (1-2 g)	S, U	Zinc sulfate	360 (@25°C)	40,900	7,583	Pickering and Henderson 1966**	Y

Appendix 2 Table 5.1: Updated zinc acute toxicity database

Species	Common name	Method <sup>a</sup>	Chemical	Hardness (mg/L as CaCO <sub>3</sub> )	Acute value (ug total Zn/L)	Adjusted acute value* (ug Zn/L)	SMAV Reference	Slope?
<i>Morone americana</i>	White perch (<20 cm)	S, M	Zinc nitrate	53	14,300	13,606	<b>13,439</b> Rehwoldt <i>et al.</i> 1971**	
<i>Morone americana</i>	White perch	S, M	--	55	14,400	13,275	Rehwoldt <i>et al.</i> 1972**	
<i>Morone saxatilis</i>	Striped bass (63 d old)	S, U	Zinc chloride	40	120	145	<b>119</b> Palawski <i>et al.</i> 1985**	Y
<i>Morone saxatilis</i>	Striped bass (63 d old)	S, U	Zinc chloride	285	430	97	Palawski <i>et al.</i> 1985**	Y
<i>Notemigonus crysoleucas</i>	Golden shinner	S, U	Zinc sulfate	50	6,000	6,000	<b>6,000</b> Cairns <i>et al.</i> 1969**	
<i>Oncorhynchus clarki</i>	Cutthroat trout	F, M	--	31.1	140	210	<b>368</b> Brinkman and Hansen 2004	Y
<i>Oncorhynchus clarki</i>	Cutthroat trout	F, M	--	149.4	1,645	646	Brinkman and Hansen 2004	Y
<i>Oncorhynchus kisutch</i>	Coho salmon (yearling)	R, M	Zinc chloride	94	4,600	2,684 <sup>T</sup>	<b>1,635</b> Lorz and McPherson 1976, 1977**	
<i>Oncorhynchus kisutch</i>	Coho salmon	F, M	Zinc chloride	25	905	1,635	Chapman and Stevens 1978**	
<i>Oncorhynchus mykiss</i>	Rainbow trout (juvenile)	F, M	Zinc sulfate	330	7,210	1,440	<b>582</b> Sinley <i>et al.</i> 1974**	Y
<i>Oncorhynchus mykiss</i>	Rainbow trout (juvenile)	F, M	Zinc sulfate	25	430	777	Sinley <i>et al.</i> 1974**	Y
<i>Oncorhynchus mykiss</i>	Rainbow trout (30.5 g)	F, M	Zinc sulfate	30	430	665	Goettl <i>et al.</i> 1974**	Y
<i>Oncorhynchus mykiss</i>	Rainbow trout (22.6 g)	F, M	Zinc sulfate	30	810	1,253	Goettl <i>et al.</i> 1974**	Y
<i>Oncorhynchus mykiss</i>	Rainbow trout (29.7 g)	F, M	Zinc sulfate	30	410	634	Goettl <i>et al.</i> 1974, 1976**	Y
<i>Oncorhynchus mykiss</i>	Rainbow trout (18.3 g)	F, M	Zinc sulfate	312	4,520	947	Goettl <i>et al.</i> 1974, 1976**	Y
<i>Oncorhynchus mykiss</i>	Rainbow trout (2.0 g)	F, M	Zinc sulfate	312	1,190	249	Goettl <i>et al.</i> 1974, 1976**	Y
<i>Oncorhynchus mykiss</i>	Rainbow trout (34.6 g)	F, M	Zinc sulfate	23	560	1,087	Goettl <i>et al.</i> 1974, 1976**	Y
<i>Oncorhynchus mykiss</i>	Rainbow trout (4.9 g)	F, M	Zinc sulfate	22	240	484	Goettl <i>et al.</i> 1974, 1976**	Y
<i>Oncorhynchus mykiss</i>	Rainbow trout (52.1 g)	F, M	Zinc sulfate	30	830	1,284	Goettl <i>et al.</i> 1974, 1976**	Y
<i>Oncorhynchus mykiss</i>	Rainbow trout (15.4 g)	F, M	Zinc sulfate	314	7,210	1,502	Goettl <i>et al.</i> 1974, 1976**	Y
<i>Oncorhynchus mykiss</i>	Rainbow trout (72 g)	F, M	Zinc sulfate	102	1,000	544	Goettl <i>et al.</i> 1974, 1976**	Y
<i>Oncorhynchus mykiss</i>	Rainbow trout (juvenile)	R, U	Zinc sulfate	5	280	1,999	McLeay 1976**	Y
<i>Oncorhynchus mykiss</i>	Rainbow trout (alevin)	F, M	Zinc chloride	23	815	1,581	Chapman 1975, 1978b**	Y
<i>Oncorhynchus mykiss</i>	Rainbow trout (swim-up alevin)	F, M	Zinc chloride	23	93	180	Chapman 1975, 1978b**	Y
<i>Oncorhynchus mykiss</i>	Rainbow trout (parr)	F, M	Zinc chloride	23	136	264	Chapman 1975, 1978b**	Y
<i>Oncorhynchus mykiss</i>	Rainbow trout (adult male)	F, M	Zinc chloride	83	1,755	1,139	Chapman and Stevens 1978**	Y
<i>Oncorhynchus mykiss</i>	Rainbow trout (juvenile)	F, M	Zinc sulfate	46.8	370	391	Holcombe and Andrew 1978**	Y
<i>Oncorhynchus mykiss</i>	Rainbow trout (juvenile)	F, M	Zinc sulfate	47	517	545	Holcombe and Andrew 1978**	Y
<i>Oncorhynchus mykiss</i>	Rainbow trout (juvenile)	F, M	Zinc sulfate	44.4	756	837	Holcombe and Andrew 1978**	Y
<i>Oncorhynchus mykiss</i>	Rainbow trout (juvenile)	F, M	Zinc sulfate	178	2,510	849	Holcombe and Andrew 1978**	Y
<i>Oncorhynchus mykiss</i>	Rainbow trout (juvenile)	F, M	Zinc sulfate	179	2,960	996	Holcombe and Andrew 1978**	Y
<i>Oncorhynchus mykiss</i>	Rainbow trout (juvenile)	F, M	Zinc sulfate	170	1,910	672	Holcombe and Andrew 1978**	Y
<i>Oncorhynchus mykiss</i>	Rainbow trout (fry)	F, M	Zinc chloride	9.2	66	280	Cusimano <i>et al.</i> 1986	Y
				(@pH=7.0)				
<i>Oncorhynchus mykiss</i>	Rainbow trout	F, M	--	350	4,520	858	Goettl <i>et al.</i> 1972	Y
<i>Oncorhynchus mykiss</i>	Rainbow trout	F, M	--	350	1,190	226	Goettl <i>et al.</i> 1972	Y
<i>Oncorhynchus mykiss</i>	Rainbow trout	F, M	--	30	560	866	Goettl <i>et al.</i> 1972	Y
<i>Oncorhynchus mykiss</i>	Rainbow trout	F, M	--	30	240	371	Goettl <i>et al.</i> 1972	Y
<i>Oncorhynchus mykiss</i>	Rainbow trout	F, M	--	38	105	133	Davies 1980	Y
<i>Oncorhynchus mykiss</i>	Rainbow trout	F, M	--	38	186	235	Davies 1980	Y

Appendix 2 Table 5.1: Updated zinc acute toxicity database

Species	Common name	Method <sup>a</sup>	Chemical	Hardness (mg/L as CaCO <sub>3</sub> )	Acute value (ug total Zn/L)	Adjusted acute value* (ug Zn/L)	SMAV Reference	Slope?
<i>Oncorhynchus mykiss</i>	Rainbow trout	F, M	--	33.2	125	177	Brinkman and Hansen 2004	Y
<i>Oncorhynchus mykiss</i>	Rainbow trout	F, M	--	145.4	588	236	Brinkman and Hansen 2004	Y
<i>Oncorhynchus mykiss</i>	Rainbow trout (fingerling)	S, M	Zinc sulfate	14	560	1,660	Spry and Wood 1984**	Y
<i>Oncorhynchus nerka</i>	Sockeye salmon (parr)	F, M	Zinc chloride	22	749	1,510	<b>1,510</b> Chapman 1975, 1978b**	
<i>Oncorhynchus tshawytscha</i>	Chinook salmon (juvenile)	F, M	Zinc sulfate	21	84	176	<b>449</b> Finlayson and Verrue 1982**	
<i>Oncorhynchus tshawytscha</i>	Chinook salmon (swim-up)	F, M	Zinc chloride	23	97	188	Chapman 1975, 1978b**	
<i>Oncorhynchus tshawytscha</i>	Chinook salmon (parr)	F, M	Zinc chloride	23	463	898	Chapman 1975, 1978b**	
<i>Oncorhynchus tshawytscha</i>	Chinook salmon (smolt)	F, M	Zinc chloride	23	701	1,360	Chapman 1975, 1978b**	
<i>Pimephales promelas</i>	Fathead minnow (embryo)	F, M	Zinc sulfate	186	1,820	593	<b>3,808</b> Pickering and Vigor 1965**	
<i>Pimephales promelas</i>	Fathead minnow (embryo)	F, M	Zinc sulfate	(174-198) 186	1,850	603	Pickering and Vigor 1965**	
<i>Pimephales promelas</i>	Fathead minnow (fry)	F, M	Zinc sulfate	(174-198) 186	870	283	Pickering and Vigor 1965**	
<i>Pimephales promelas</i>	Fathead minnow (1-2 g)	F, M	Zinc sulfate	63	12,500	10,262	Mount 1966**	Y
<i>Pimephales promelas</i>	Fathead minnow (1-2 g)	F, M	Zinc sulfate	54	13,800	12,922	Mount 1966**	Y
<i>Pimephales promelas</i>	Fathead minnow (1-2 g)	F, M	Zinc sulfate	97	18,500	10,507	Mount 1966**	Y
<i>Pimephales promelas</i>	Fathead minnow (1-2 g)	F, M	Zinc sulfate	103	25,000	13,489	Mount 1966**	Y
<i>Pimephales promelas</i>	Fathead minnow (1-2 g)	F, M	Zinc sulfate	212	29,000	8,449	Mount 1966**	Y
<i>Pimephales promelas</i>	Fathead minnow (1-2 g)	F, M	Zinc sulfate	208	35,500	10,513	Mount 1966**	Y
<i>Pimephales promelas</i>	Fathead minnow (1-2 g)	F, M	Zinc sulfate	54	13,700	12,829	Mount 1966**	Y
<i>Pimephales promelas</i>	Fathead minnow (1-2 g)	F, M	Zinc sulfate	63	6,200	5,090	Mount 1966**	Y
<i>Pimephales promelas</i>	Fathead minnow (1-2 g)	F, M	Zinc sulfate	100	12,500	6,917	Mount 1966**	Y
<i>Pimephales promelas</i>	Fathead minnow (1-2 g)	F, M	Zinc sulfate	99	12,500	6,977	Mount 1966**	Y
<i>Pimephales promelas</i>	Fathead minnow (1-2 g)	F, M	Zinc sulfate	186	19,000	6,190	Mount 1966**	Y
<i>Pimephales promelas</i>	Fathead minnow (1-2 g)	F, M	Zinc sulfate	195	13,600	4,255	Mount 1966**	Y
<i>Pimephales promelas</i>	Fathead minnow (1-2 g)	F, M	Zinc sulfate	54	4,700	4,401	Mount 1966**	Y
<i>Pimephales promelas</i>	Fathead minnow (1-2 g)	F, M	Zinc sulfate	49	5,100	5,189	Mount 1966**	Y
<i>Pimephales promelas</i>	Fathead minnow (1-2 g)	F, M	Zinc sulfate	98	8,100	4,560	Mount 1966**	Y
<i>Pimephales promelas</i>	Fathead minnow (1-2 g)	F, M	Zinc sulfate	102	9,900	5,386	Mount 1966**	Y
<i>Pimephales promelas</i>	Fathead minnow (1-2 g)	F, M	Zinc sulfate	193	8,200	2,588	Mount 1966**	Y
<i>Pimephales promelas</i>	Fathead minnow (1-2 g)	F, M	Zinc sulfate	216	15,500	4,444	Mount 1966**	Y
<i>Pimephales promelas</i>	Fathead minnow (2-3 g)	F, M	Zinc sulfate	203	8,400	2,540	Brungs 1969**	Y
<i>Pimephales promelas</i>	Fathead minnow (2-3 g)	F, M	Zinc sulfate	203	10,000	3,023	Brungs 1969**	Y
<i>Pimephales promelas</i>	Fathead minnow (4 wk)	F, M	Zinc sulfate	46	600	644	Benoit and Holcombe 1978**	
<i>Pimephales promelas</i>	Fathead minnow (1-2 g)	S, M	Zinc sulfate	45	2,100	2,298	Judy and Davies 1979**	
<i>Pimephales promelas</i>	Fathead minnow (juvenile)	F, M	Zinc sulfate	220	2,610	737	Broderius and Smith 1979**	
<i>Pimephales promelas</i>	Fathead minnow (larva)	S, M	Zinc chloride	45	396	433	Carison and Roush 1985**	
<i>Pimephales promelas</i>	Fathead minnow (<24 hr)	S, M	Zinc chloride	52	551	533	Carison <i>et al.</i> 1986**	
<i>Pimephales promelas</i>	Fathead minnow (44.6 mm)	S, U	Zinc sulfate	166	7,630	2,739	Rachlin and Perimutter 1968**	
<i>Pimephales promelas</i>	Fathead minnow (2-3 g)	S, U	Zinc sulfate	203	12,000	3,628	Brungs 1969**	Y

Appendix 2 Table 5.1: Updated zinc acute toxicity database

Species	Common name	Method <sup>a</sup>	Chemical	Hardness (mg/L as CaCO <sub>3</sub> )	Acute value (ug total Zn/L)	Adjusted acute value* (ug total Zn/L)	SMAV Reference	Slope?
<i>Pimephales promelas</i>	Fathead minnow (2-3 g)	S, U	Zinc sulfate	203	13,000	3,930	Brungs 1969**	Y
<i>Pimephales promelas</i>	Fathead minnow (1-2 g)	S, U	Zinc sulfate	20	2,550	5,575	Pickering and Henderson 1966**	Y
				(@15°C)				
<i>Pimephales promelas</i>	Fathead minnow (1-2 g)	S, U	--	20	2,330	5,094	Pickering and Henderson 1966**	Y
				(@15°C)				
<i>Pimephales promelas</i>	Fathead minnow (1-2 g)	S, U	Zinc sulfate	20	770	1,683	Pickering and Henderson 1966**	Y
				(@25°C)	(780)			
<i>Pimephales promelas</i>	Fathead minnow (1-2 g)	S, U	Zinc sulfate	20	960	2,099	Pickering and Henderson 1966**	Y
				(@25°C)				
<i>Pimephales promelas</i>	Fathead minnow (1-2 g)	S, U	Zinc sulfate	360	33,400	6,192	Pickering and Henderson 1966**	Y
				(@25°C)				
<i>Poecilia reticulata</i>	Guppy (6 mo)	S, U	Zinc sulfate	20	1,270	2,777	<b>5,926</b> Pickering and Henderson 1966**	Y
<i>Poecilia reticulata</i>	Guppy	S, U	Zinc sulfate	120	30,000	14,208	Cairns et al. 1969**	Y
<i>Poecilia reticulata</i>	Guppy (fry)	S, M	Zinc sulfate	30	1,740	2,691	Pierson 1981**	Y
<i>Poecilia reticulata</i>	Guppy (adult male)	S, M	Zinc sulfate	30	5,050	7,811	Pierson 1981**	Y
<i>Poecilia reticulata</i>	Guppy (adult female)	S, M	Zinc sulfate	30	6,400	9,899	Pierson 1981**	Y
<i>Poecilia reticulata</i>	Guppy (adult male)	S, U	Zinc sulfate	118	300,000	144,134	Sehgal and Saxena 1986**	
<i>Poecilia reticulata</i>	Guppy (adult female)	S, U	Zinc sulfate	118	278,000	133,564	Sehgal and Saxena 1986**	
<i>Ptychocheilus lusius</i>	Colorado pikeminnow (larvae)	S,U	Zinc chloride	199	3,340	1,027	<b>2,211</b> Buhl and Hamilton 1996	
<i>Ptychocheilus lusius</i>	Colorado pikeminnow (juvenile)	S,U	Zinc chloride	199	8,620	2,651	Buhl and Hamilton 1996	
<i>Ptychocheilus lusius</i>	Colorado pikeminnow (larvae)	S,U	Zinc sulfate	144	9,800	3,972	Hamilton and Buhl 1997b	
<i>Ptychocheilus oregonensis</i>	Northern pikeminnow (juvenile)	F, M	Zinc chloride	25	3,498	6,321	<b>6,495</b> Andros and Garton 1980**	
				(20-30)				
<i>Ptychocheilus oregonensis</i>	Northern pikeminnow (juvenile)	F, M	Zinc chloride	25	3,693	6,674	Andros and Garton 1980**	
				(20-30)				
<i>Salmo salar</i>	Atlantic salmon (parr)	F, M	Zinc sulfate	14	740	2,194	<b>2,194</b> Carson and Carson 1972**	
<i>Salmo trutta</i>	Brown Trout	F, M	Zinc sulfate	206.7	2,267	675	<b>647</b> Davies and Brinkman, 1999	Y
				(alk = 37.5)				
<i>Salmo trutta</i>	Brown Trout	F, M	Zinc sulfate	54.4	1,033	961	Davies and Brinkman, 1999	
				(alk = 37.4)				
<i>Salmo trutta</i>	Brown Trout	F, M	Zinc sulfate	54.0	690	646	Davies and Brinkman, 1999	Y
				(alk = 139.6)				
<i>Salmo trutta</i>	Brown Trout	F, M	Zinc sulfate	207.2	>2,660	>790	Davies and Brinkman, 1999	Y
				(alk = 141.4)				
<i>Salmo trutta</i>	Brown Trout	F, M	Zinc sulfate	51.9	871	844	Davies and Brinkman, 2000	Y
<i>Salmo trutta</i>	Brown Trout	F, M	Zinc sulfate	51.8	392	380	Davies and Brinkman, 2000	Y

Appendix 2 Table 5.1: Updated zinc acute toxicity database

Species	Common name	Method <sup>a</sup>	Chemical	Hardness (mg/L as CaCO <sub>3</sub> )	Acute value (ug total Zn/L)	Adjusted acute value* (ug Zn/L)	SMAV Reference	Slope?
				(2 wk de-acli)				
<i>Salmo trutta</i>	Brown Trout (wild)	F, M	--	37.6	642	819	Davies and Brinkman, 1994	Y
<i>Salmo trutta</i>	Brown Trout	F, M	--	42.3	476	549	Davies <i>et al.</i> 2000	Y
<i>Salmo trutta</i>	Brown Trout	F, M	--	52.6	484	464	Davies <i>et al.</i> 2000	Y
<i>Salmo trutta</i>	Brown Trout	F, M	--	52.6	603	577	Davies <i>et al.</i> 2000	Y
<i>Salvelinus fontinalis</i>	Brook trout (juvenile)	F, M	Zinc sulfate	46.8	1,550	1,640	<b>1,691</b> Holcombe & Andrew 1978**	Y
<i>Salvelinus fontinalis</i>	Brook trout (juvenile)	F, M	Zinc sulfate	47	2,120	2,235	Holcombe & Andrew 1978**	Y
<i>Salvelinus fontinalis</i>	Brook trout (juvenile)	F, M	Zinc sulfate	44.4	2,420	2,678	Holcombe & Andrew 1978**	Y
<i>Salvelinus fontinalis</i>	Brook trout (juvenile)	F, M	Zinc sulfate	178	6,140	2,077	Holcombe & Andrew 1978**	Y
<i>Salvelinus fontinalis</i>	Brook trout (juvenile)	F, M	Zinc sulfate	179	6,980	2,350	Holcombe & Andrew 1978**	Y
<i>Salvelinus fontinalis</i>	Brook trout (juvenile)	F, M	Zinc sulfate	170	4,980	1,752	Holcombe & Andrew 1978**	Y
<i>Salvelinus fontinalis</i>	Brook trout	F, M	--	52.6	738	707	Davies <i>et al.</i> 2000	Y
<i>Salvelinus fontinalis</i>	Brook trout	F, M	--	52.6	1,178	1,128	Davies <i>et al.</i> 2000	Y
<i>Tilapia mossambica</i>	Mozambique tilapia (18 g)	S, U	Zinc chloride	115	1,600	786	<b>786</b> Qureshi and Saksena 1980**	
<i>Thymallus arcticus</i>	Arctic grayling (0.34g)	S, U	Zinc chloride	41.3	112	132	<b>199</b> Buhl and Hamilton 1990	
<i>Thymallus arcticus</i>	Arctic grayling (0.2g)	S, U	Zinc chloride	41.3	142	167	Buhl and Hamilton 1990	
<i>Thymallus arcticus</i>	Arctic grayling (0.85g)	S, U	Zinc chloride	41.3	166	195	Buhl and Hamilton 1990	
<i>Thymallus arcticus</i>	Arctic grayling (0.97g)	S, U	Zinc chloride	41.3	168	198	Buhl and Hamilton 1990	
<i>Thymallus arcticus</i>	Arctic grayling (1.85g)	S, U	Zinc chloride	41.3	168	198	Buhl and Hamilton 1990	
<i>Thymallus arcticus</i>	Arctic grayling (fry)	S, U	Zinc chloride	41.3	315	371	Buhl and Hamilton 1990	
<i>Thymallus arcticus</i>	Arctic grayling (alevin)	S, U	Zinc chloride	41.3	1,580	1,860	Buhl and Hamilton 1990	
<i>Thymallus arcticus</i>	Arctic grayling (alevin)	S, U	Zinc chloride	41.3	2,920	3,438	Buhl and Hamilton 1990	
<i>Xenopus laevis</i>	Frog	S, M		100	34,500	19,091	<b>19,091</b> Dawson <i>et al.</i> 1988***	
<i>Xiphophorus maculatus</i>	Southern platyfish (20.8)	S, U	Zinc sulfate	166	12,000	4,308	<b>4,308</b> Rachlin and Perimutter 1968**	
<i>Xyrauchen texanus</i>	Razorback sucker (larvae)	S,U	Zinc chloride	199	4,100	1,261	<b>1,651</b> Buhl and Hamilton 1996	
<i>Xyrauchen texanus</i>	Razorback sucker (juvenile)	S,U	Zinc chloride	199	2,920	898	Buhl and Hamilton 1996	
<i>Xyrauchen texanus</i>	Razorback sucker (larvae)	S,U	Zinc sulfate	144	9,800	3,972	Hamilton and Buhl 1997b	

\* acute values adjusted to hardness = 50 mg/L with revised slope of 0.85

\*\* as cited in U.S. EPA Zinc Document (1987)

\*\*\* as cited in U.S. EPA 1995 Updates (1996)

<sup>a</sup> F = flow-through. S = static. R = renewal. M = measured. U = unmeasured. T = total. D = dissolved

<sup>†</sup> not used in SMAV calculation, see text for detail

Appendix 2 Table 5.2: Updated zinc chronic toxicity database

Species	Common name	Hardness (mg/L as CaCO <sub>3</sub> )	Chronic value (µg total Zn/L)	Normalized chronic value* (µg total Zn/L)	SMCV Reference
<i>Acroneuria lycorias</i>	Stonefly	50	32,000	32,000	<b>32,000</b> Warrick and Bell 1969
<i>Bryocamptus zschokkei</i>	Copepod	100	380	210	<b>210</b> Brown et al. 2005
<i>Clistoronia magnifica</i>	Caddisfly	31	>5243	>7,885	<b>&gt;7,885</b> Nebeker et al. 1984
<i>Daphnia magna</i>	Cladoceran	45	<140	<154	<b>&lt;51</b> Blesinger et al. 1986
<i>Daphnia magna</i>	Cladoceran	52	136	131	Chapman et al. Manuscript
<i>Daphnia magna</i>	Cladoceran	104	47	25	Chapman et al. Manuscript
<i>Daphnia magna</i>	Cladoceran	211	47	14	Chapman et al. Manuscript
<i>Drunella grandis</i>	Mayfly	50	>9,200	>9,200	<b>&gt;9,200</b> Nehring 1976
<i>Ephemera subvaria</i>	Mayfly	54	16,000	14,983	<b>14,983</b> Warrick and Bell 1969
<i>Hydropsyche betteni</i>	Caddisfly	52	32,000	30,946	<b>30,946</b> Warrick and Bell 1969
<i>Pteronarcys californica</i>	Stonefly	50	>13,900	>13,900	<b>&gt;13,900</b> Nehring 1976
<i>Tanytarsus</i> sp.	Midge	46.8	37	39	<b>39</b> Anderson et al. 1980
<i>Cottus bairdi</i>	Mottled sculpin	46.3	21	22	<b>47</b> Woodling et al. 2002
<i>Cottus bairdi</i>	Mottled sculpin	154	255	98	Brinkman and Woodling 2005
<i>Jordanella floridae</i>	Flagfish	44	36	41	<b>41</b> Spehar 1976a,b
<i>Oncorhynchus clarkii</i>	Cutthroat trout	40.5	670	802	<b>440</b> Nehring and Goettl 1974
<i>Oncorhynchus clarkii</i>	Cutthroat trout	31.1	134	201	Brinkman and Hansen 2004
<i>Oncorhynchus clarkii</i>	Cutthroat trout	149.4	1,343	528	Brinkman and Hansen 2004
<i>Oncorhynchus mykiss</i>	Rainbow trout	26	277	484	<b>292</b> Sinley et al. 1974
<i>Oncorhynchus mykiss</i>	Rainbow trout	25	603	1,090*	Cairns et al. 1982
<i>Oncorhynchus mykiss</i>	Rainbow trout	33.2	74	105	Brinkman and Hansen 2004
<i>Oncorhynchus mykiss</i>	Rainbow trout	145.4	325	131	Brinkman and Hansen 2004
<i>Oncorhynchus nerka</i>	Sockeye salmon	34.5	242	332	<b>332</b> Chapman 1978a
<i>Oncorhynchus tshawytscha</i>	Chinook salmon	25	371	671	<b>671</b> Chapman 1975
<i>Pimephales promelas</i>	Fathead minnow	46	106	114	<b>114</b> Benoit and Holcombe 1978
<i>Poecilia reticulata</i>	Guppy	30	<173	<268	<b>&lt;268</b> Pierson 1981
<i>Salmo trutta</i>	Brown trout	39	457	565	<b>377</b> Davies and Brinkman 1994
<i>Salmo trutta</i>	Brown trout	52.6	234	224	Davies et al. 2000
<i>Salmo trutta</i>	Brown trout	52.6	327	313	Davies et al. 2000
<i>Salmo trutta</i>	Brown trout	28.5	640	1,034	Nehring and Goettl 1974
<i>Salmo trutta</i>	Brown trout	26.8	162	276	Davies and Brinkman 1999, 2002, 2003
<i>Salmo trutta</i>	Brown trout	48.1	196	203	Davies and Brinkman 1999, 2002, 2003
<i>Salmo trutta</i>	Brown trout	54.1	381	356	Davies and Brinkman 1999, 2002, 2003
<i>Salmo trutta</i>	Brown trout	153	1,306	503	Davies and Brinkman 1999, 2002, 2003
<i>Salvelinus fontinalis</i>	Brook trout	45.9	855	919	<b>609</b> Holcombe et al. 1979
<i>Salvelinus fontinalis</i>	Brook trout	52.6	327	313	Davies et al. 2000
<i>Salvelinus fontinalis</i>	Brook trout	52.6	819	784	Davies et al. 2000

\* not used in SMCV calculation, see text for details