Table 1a. Acute Toxicity of Copper to Freshwater Animals

Species[a]	Organism Age, Size, or Lifestage	Method[b]	Chemical[c]	Reported LC50 or EC50 (total µg/L)[d]	Reported LC50 or EC50 (Diss. µg/L)[e]	BLM Data Label	BLM Normalized LC50 or EC50 (µg/L)[f]	Species Mean Acute Value (µg/L)[g]	Reference
Worm,	adult (mixed age)	S,M,T	N	130	---	LUVA01S	39.06	50.12	Schubauer-Berigan et al. 1993
Lumbriculus variegatus	adult (mixed age)	S,M,T	N	270	---	LUVA02S	57.44		Schubauer-Berigan et al. 1993
	adult (mixed age)	S,M,T	N	500	---	LUVA03S	56.12		Schubauer-Berigan et al. 1993
Snail,	1.1-2.7 cm	F,M,T	S	2000	---	CADE01F	3661	3027	Arthur and Leonard 1970
Campeloma decisum	1.1-2.7 cm	F,M,T	S	1400	---	CADE02F	2502		Arthur and Leonard 1970
Snail, *Juga plicifera*	adult	F,M,T	C	15	---	JUPL01F	10.84	10.84	Nebeker et al. 1986b
Snail, *Lithoglyphus virens*	adult	F,M,T	C	8	---	LIVI01F	5.75	5.75	Nebeker et al. 1986b
Snail,	0.4-0.7 cm	F,M,T	S	41	---	PHIN01F	19.91	18.60	Arthur and Leonard 1970
Physa integra	0.4-0.7 cm	F,M,T	S	37	---	PHIN02F	17.37		Arthur and Leonard 1970
Freshwater mussel,	juvenile	S,M,T	S	27	---	ACPE01S	10.47	11.35	Keller unpublished
Actinonaias pectorosa	juvenile	S,M,T	S	<29	---	ACPE02S	12.31		Keller unpublished
Freshwater mussel,	1-2 d juv	S,M,T	S	86	---	UTIM01S	170.8	35.97	Keller and Zam 1991
Utterbackia imbecillis	1-2 d juv	S,M,T	S	199	---	UTIM02S	175.3		Keller and Zam 1991
	juvenile	S,M,T	N	76	---	UTIM03S	36.22		Keller unpublished
	juvenile	S,M,T	N	85	---	UTIM04S	38.09		Keller unpublished
	juvenile	S,M,T	N	41	---	UTIM05S	21.54		Keller unpublished
	juvenile	S,M,T	S	79	---	UTIM06S	41.38		Keller unpublished
	juvenile	S,M,T	S	72	---	UTIM07S	35.34		Keller unpublished
	juvenile	S,M,T	S	38	---	UTIM08S	29.87		Keller unpublished
Cladoceran,	<4 h	S,M,T	C	19	---	CEDU01S	9.24	5.75	Carlson et al. 1986
Ceriodaphnia dubia	<4 h	S,M,T	C	17	---	CEDU02S	8.24		Carlson et al. 1986
	<12 h	S,M,D	---	-	25	CEDU03S	7.25		Belanger et al. 1989
	<12 h	S,M,D	---	-	17	CEDU04S	4.71		Belanger et al. 1989
	<12 h	S,M,D	---	-	30	CEDU05S	8.96		Belanger et al. 1989
	<12 h	S,M,D	---	-	24	CEDU06S	6.92		Belanger et al. 1989
	<12 h	S,M,D	---	-	28	CEDU07S	8.26		Belanger et al. 1989
	<12 h	S,M,D	---	-	32	CEDU08S	9.67		Belanger et al. 1989
	<12 h	S,M,D	---	-	23	CEDU09S	6.60		Belanger et al. 1989
	<12 h	S,M,D	---	-	20	CEDU10S	5.64		Belanger et al. 1989
	<12 h	S,M,D	---	-	19	CEDU11S	5.33		Belanger et al. 1989
	<12 h	S,M,D	---	-	26	CEDU12S	2.99		Belanger et al. 1989
	<12 h	S,M,D	---	-	21	CEDU13S	2.36		Belanger et al. 1989
	<12 h	S,M,D	---	-	27	CEDU14S	3.12		Belanger et al. 1989
	<12 h	S,M,D	---	-	37	CEDU15S	4.51		Belanger et al. 1989
	<12 h	S,M,D	---	-	34	CEDU16S	4.07		Belanger et al. 1989
	<12 h	S,M,D	---	-	67	CEDU17S	5.16		Belanger et al. 1989
	<12 h	S,M,D	---	-	38	CEDU18S	2.52		Belanger et al. 1989
	<12 h	S,M,D	---	-	78	CEDU19S	6.35		Belanger et al. 1989
	<12 h	S,M,D	---	-	81	CEDU20S	6.70		Belanger et al. 1989
	<12 h	S,M,D	---	-	28	CEDU21S	3.97		Belanger and Cherry 1990
	<12 h	S,M,D	---	-	84	CEDU22S	10.21		Belanger and Cherry 1990

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	<12 h	S,M,T	S	13.4	---	CEDU23S	6.10		Oris et al. 1991
	<24 h	R,M,T,D	S	6.98	5.54	CEDU24R	5.06		Diamond et al. 1997b
Cladoceran,	1 d	S,M,T	C	9.1	---	DAMA01S	2.93	4.98	Nebeker et al. 1986a
Daphnia magna	1 d	S,M,T	C	11.7	---	DAMA02S	3.83		Nebeker et al. 1986a
	<2 h	S,M,T	C	6.6	---	DAMA03S	2.12		Nebeker et al. 1986a
	<2 h	S,M,T	C	9.9	---	DAMA04S	3.25		Nebeker et al. 1986a
	1 d	S,M,T	C	11.7	---	DAMA05S	12.06		Nebeker et al. 1986a
	<4 h	S,M,T	C	6.7	---	DAMA06S	7.26		Nebeker et al. 1986a
	1 d	S,M,T	C	9.1	---	DAMA07S	3.76		Nebeker et al. 1986a
	<2 h	S,M,T	C	5.2	---	DAMA08S	1.80		Nebeker et al. 1986a
	<24 h	S,M,T	S	41.2	---	DAMA09S	22.21		Baird et al. 1991
	<24 h	S,M,T	S	10.5	---	DAMA10S	5.83		Baird et al. 1991
	<24 h	S,M,T	S	20.6	---	DAMA11S	11.68		Baird et al. 1991
	<24 h	S,M,T	S	17.3	---	DAMA12S	9.77		Baird et al. 1991
	<24 h	S,M,T	S	70.7	---	DAMA13S	34.71		Baird et al. 1991
	<24 h	S,M,T	S	31.3	---	DAMA14S	17.37		Baird et al. 1991
	<24 h	S,M,I	S	7.1	---	DAMA15S	2.08		Meador 1991
	<24 h	S,M,I	S	16.4	---	DAMA16S	3.38		Meador 1991
	<24 h	S,M,I	S	39.9	---	DAMA17S	4.16		Meador 1991
	<24 h	S,M,I	S	18.7	---	DAMA18S	2.68		Meador 1991
	<24 h	S,M,I	S	18.9	---	DAMA19S	1.53		Meador 1991
	<24 h	S,M,I	S	39.7	---	DAMA20S	2.38		Meador 1991
	<24 h	S,M,I	S	46	---	DAMA21S	7.37		Meador 1991
	<24 h	S,M,I	S	71.9	---	DAMA22S	8.26		Meador 1991
	<24 h	S,M,I	S	57.2	---	DAMA23S	4.65		Meador 1991
	<24 h	S,M,I	S	67.8	---	DAMA24S	3.30		Meador 1991
	<24 h	S,M,T	C	26	---	DAMA25S	9.24		Chapman et al. Manuscript
	<24 h	S,M,T	C	30	---	DAMA26S	8.09		Chapman et al. Manuscript
	<24 h	S,M,T	C	38	---	DAMA27S	8.84		Chapman et al. Manuscript
	<24 h	S,M,T	C	69	---	DAMA28S	11.12		Chapman et al. Manuscript
	<24 h	S,M,T,D	S	4.8	---	DAMA29S	1.08		Long's MS Thesis
	<24 h	S,M,T,D	S	7.4	---	DAMA30S	15.57		Long's MS Thesis
	<24 h	S,M,T,D	S	6.5	---	DAMA31S	2.17		Long's MS Thesis
Cladoceran,	---	S,M,T	S	11.4	---	DAPC01S	1.37	2.54	Lind et al. Manuscript (1978)
Daphnia pulicaria	---	S,M,T	S	9.06	---	DAPC02S	0.87		Lind et al. Manuscript (1978)
	---	S,M,T	S	7.24	---	DAPC03S	0.74		Lind et al. Manuscript (1978)
	---	S,M,T	S	10.8	---	DAPC04S	0.94		Lind et al. Manuscript (1978)
	---	S,M,T	S	55.4	---	DAPC05S	7.87		Lind et al. Manuscript (1978)
	---	S,M,T	S	55.3	---	DAPC06S	5.33		Lind et al. Manuscript (1978)
	---	S,M,T	S	53.3	---	DAPC07S	3.59		Lind et al. Manuscript (1978)
	---	S,M,T	S	97.2	---	DAPC08S	3.59		Lind et al. Manuscript (1978)
	---	S,M,T	S	199	---	DAPC09S	2.70		Lind et al. Manuscript (1978)
	---	S,M,T	S	213	---	DAPC10S	7.02		Lind et al. Manuscript (1978)

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	---	S,M,T	S	165	---	DAPC11S	5.28		Lind et al. Manuscript (1978)
	---	S,M,T	S	35.5	---	DAPC12S	1.45		Lind et al. Manuscript (1978)
	---	S,M,T	S	78.8	---	DAPC13S	2.29		Lind et al. Manuscript (1978)
	---	S,M,T	S	113	---	DAPC14S	0.98		Lind et al. Manuscript (1978)
	---	S,M,T	S	76.4	---	DAPC15S	1.89		Lind et al. Manuscript (1978)
	---	S,M,T	S	84.7	---	DAPC16S	6.27		Lind et al. Manuscript (1978)
	---	S,M,T	S	184	---	DAPC17S	6.78		Lind et al. Manuscript (1978)
	---	S,M,T	S	9.3	---	DAPC18S	0.93		Lind et al. Manuscript (1978)
	---	S,M,T	S	17.8	---	DAPC19S	1.69		Lind et al. Manuscript (1978)
	---	S,M,T	S	23.7	---	DAPC20S	2.13		Lind et al. Manuscript (1978)
	---	S,M,T	S	27.3	---	DAPC21S	2.17		Lind et al. Manuscript (1978)
	---	S,M,T	S	25.2	---	DAPC22S	3.40		Lind et al. Manuscript (1978)
	---	S,M,T	S	25.1	---	DAPC23S	3.93		Lind et al. Manuscript (1978)
	---	S,M,T	S	25.1	---	DAPC24S	4.66		Lind et al. Manuscript (1978)
Cladoceran, *Scapholeberis sp.*	adult	S,M,T	C	18	---	SCSP01S	8.77	8.77	Carlson et al. 1986
Amphipod,	1-3 d	F,M,T	S	22	---	GAPS01F	9.31	8.57	Arthur and Leonard 1970
Gammarus	1-3 d	F,M,T	S	19	---	GAPS02F	7.88		Arthur and Leonard 1970
Amphipod,	7-14 d	S,M,T	N	17	---	HYAZ01S	12.50	11.36	Schubauer-Berigan et al. 1993
Hyalella azteca	7-14 d	S,M,T	N	24	---	HYAZ02S	10.24		Schubauer-Berigan et al. 1993
	7-14 d	S,M,T	N	87	---	HYAZ03S	16.20		Schubauer-Berigan et al. 1993
	<7 d	S,M,T	S	24.3	---	HYAZ04S	7.19		Welsh 1996
	<7 d	S,M,T	S	23.8	---	HYAZ05S	7.03		Welsh 1996
	<7 d	S,M,T	S	8.2	---	HYAZ06S	13.79		Welsh 1996
	<7 d	S,M,T	S	10	---	HYAZ07S	16.83		Welsh 1996
Stonefly, *Acroneuria lycorias*	---	S,M,T	S	8300	---	ACLY01S	17484	17484	Warnick and Bell 1969
Midge, *Chironomus decorus*	4th instar	S,M,T	S	739	---	CHDE01S	1925	1925	Kosalwat and Knight 1987
Shovelnose sturgeon, *Scaphirhynchus platorynchus*	fry, 6.01 cm, 0.719 g	S,M,T	S	160	---	SCPL01S	72.50	72.50	Dwyer et al. 1999
Apache trout, *Oncorhynchus apache*	larval, 0.38 g	S,M,T	S	70	---	ONAP01S	33.70	33.70	Dwyer et al. 1995
Lahontan cutthroat trout,	larval, 0.34 g	S,M,T	S	80	---	ONCL01S	35.50	31.28	Dwyer et al. 1995
Oncorhynchus clarki henshawi	larval, 0.57 g	S,M,T	S	60	---	ONCL02S	25.55		Dwyer et al. 1995

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Cutthroat trout,	7.4 cm, 4.2 g	F,M,T,D	C	398.91	367	ONCL03F	69.79		Chakoumakos et al. 1979
Oncorhynchus clarki	6.9 cm, 3.2 g	F,M,T,D	C	197.87	186	ONCL04F	42.67		Chakoumakos et al. 1979
	8.8 cm, 9.7 g	F,M,T,D	C	41.35	36.8	ONCL05F	19.52		Chakoumakos et al. 1979
	8.1 cm, 4.4 g	F,M,T,D	C	282.93	232	ONCL06F	47.53		Chakoumakos et al. 1979
	6.8 cm, 2.7 g	F,M,T,D	C	186.21	162	ONCL07F	109.1		Chakoumakos et al. 1979
	7.0 cm, 3.2 g	F,M,T,D	C	85.58	73.6	ONCL08F	36.29		Chakoumakos et al. 1979
	8.5 cm, 5.2 g	F,M,T,D	C	116.67	91	ONCL09F	17.19		Chakoumakos et al. 1979
	7.7 cm, 4.4 g	F,M,T,D	C	56.20	44.4	ONCL10F	16.79		Chakoumakos et al. 1979
	8.9 cm, 5.7 g	F,M,T,D	C	21.22	15.7	ONCL11F	9.80		Chakoumakos et al. 1979
Pink salmon,	alevin (newly hatched	F,M,T	S	143	---	ONGO01F	38.75	37.30	Servizi and Martens 1978
Oncorhynchus gorbuscha	alevin	F,M,T	S	87	---	ONGO02F	18.46		Servizi and Martens 1978
	fry	F,M,T	S	199	---	ONGO03F	72.52		Servizi and Martens 1978
Coho salmon,	6 g	R,M,T,I	---	164	---	ONKI01R	91.75	15.98	Buckley 1983
Oncorhynchus kisutch	parr	F,M,T	C	33	---	ONKI02F	18.70		Chapman 1975
	adult, 2.7 kg	F,M,T	C	46	---	ONKI03F	29.13		Chapman and Stevens 1978
	fry	F,M,T,D,I	---	61	49	ONKI04F	11.42		Mudge et al. 1993
	smolt	F,M,T,D,I	---	63	51	ONKI05F	11.90		Mudge et al. 1993
	fry	F,M,T,D,I	---	86	58	ONKI06F	10.76		Mudge et al. 1993
	parr	F,M,T,D,I	---	103	78	ONKI07F	20.95		Mudge et al. 1993
Rainbow trout,	larval, 0.67 g	S,M,T	S	110	---	ONMY01S	43.37	21.60	Dwyer et al. 1995
Oncorhynchus mykiss	larval, 0.48 g	S,M,T	S	50	---	ONMY02S	26.12		Dwyer et al. 1995
	larval, 0.50 g	S,M,T	S	60	---	ONMY03S	30.49		Dwyer et al. 1995
	swim-up, 0.25 g	R,M,T,D	C	46.7	40	ONMY04R	10.21		Cacela et al. 1996
	swim-up, 0.25 g	R,M,T,D	C	24.2	19	ONMY05R	9.04		Cacela et al. 1996
	swim-up, 0.20-0.24 g	R,M,T,D	C	0	3.4	ONMY06R	5.49		Welsh et al. 2000
	swim-up, 0.20-0.24 g	R,M,T,D	C	0	8.1	ONMY07R	10.29		Welsh et al. 2000
	swim-up, 0.20-0.24 g	R,M,T,D	C	0	17.2	ONMY08R	14.63		Welsh et al. 2000
	swim-up, 0.20-0.24 g	R,M,T,D	C	0	32	ONMY09R	20.86		Welsh et al. 2000
	alevin	F,M,T	C	28	---	ONMY10F	18.16		Chapman 1975, 1978
	swim-up, 0.17 g	F,M,T	C	17	---	ONMY11F	11.06		Chapman 1975, 1978
	parr, 8.6 cm, 6.96 g	F,M,T	C	18	---	ONMY12F	8.63		Chapman 1975, 1978
	smolt, 18.8 cm, 68.19	F,M,T	C	29	---	ONMY13F	20.04		Chapman 1975, 1978
	1 g	F,M,T,D	C	-	169	ONMY14F	22.60		Chakoumakos et al. 1979
	4.9 cm	F,M,T,D	C	-	85.3	ONMY15F	9.77		Chakoumakos et al. 1979
	6.0 cm, 2.1 g	F,M,T,D	C	-	83.3	ONMY16F	9.50		Chakoumakos et al. 1979
	6.1 cm, 2.5 g	F,M,T,D	C	-	103	ONMY17F	12.21		Chakoumakos et al. 1979
	2.6 g	F,M,T,D	C	-	274	ONMY18F	42.87		Chakoumakos et al. 1979
	4.3 g	F,M,T,D	C	-	128	ONMY19F	15.91		Chakoumakos et al. 1979
	9.2 cm, 9.4 g	F,M,T,D	C	-	221	ONMY20F	32.16		Chakoumakos et al. 1979
	9.9 cm, 11.5 g	F,M,T,D	C	-	165	ONMY21F	21.91		Chakoumakos et al. 1979
	11.8 cm, 18.7 g	F,M,T,D	C	-	197	ONMY22F	27.61		Chakoumakos et al. 1979
	13.5 cm, 24.9 g	F,M,T,D	C	-	514	ONMY23F	95.34		Chakoumakos et al. 1979
	13.4 cm, 25.6 g	F,M,T,D	C	-	243	ONMY24F	36.51		Chakoumakos et al. 1979

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	6.7 cm, 2.65 g	F,M,T	C	2.8	---	ONMY25F	5.83		Cusimano et al. 1986
	parr	F,M,T,D,I	---	90	68	ONMY26F	17.96		Mudge et al. 1993
	swim-up, 0.29 g	F,M,T,D	C	19.6	18	ONMY27F	8.85		Cacela et al. 1996
	swim-up, 0.25 g	F,M,T,D	C	12.9	12	ONMY28F	34.48		Cacela et al. 1996
	swim-up, 0.23 g	F,M,T,D	C	5.9	5.7	ONMY29F	23.48		Cacela et al. 1996
	swim-up, 0.23 g	F,M,T,D	C	37.8	35	ONMY30F	15.35		Cacela et al. 1996
	swim-up, 0.26 g	F,M,T,D	C	25.1	18	ONMY31F	35.69		Cacela et al. 1996
	swim-up, 0.23 g	F,M,T,D	C	17.2	17	ONMY32F	24.39		Cacela et al. 1996
	0.64 g, 4.1 cm	F,M,T,D	C	101	---	ONMY33F	42.35		Hansen et al. 2000
	0.35 g, 3.4 cm	F,M,T,D	C	308	---	ONMY34F	94.18		Hansen et al. 2000
	0.68 g, 4.2 cm	F,M,T,D	C	93	---	ONMY35F	100.8		Hansen et al. 2000
	0.43 g, 3.7 cm	F,M,T,D	C	35.9	---	ONMY36F	52.78		Hansen et al. 2000
	0.29 g, 3.4 cm	F,M,T,D	C	54.4	---	ONMY37F	49.46		Hansen et al. 2000
Sockeye salmon,	alevin (newly hatched	F,M,T	S	190	---	ONNE01F	65.95	50.83	Servizi and Martens 1978
Oncorhynchus nerka	alevin	F,M,T	S	200	---	ONNE02F	73.27		Servizi and Martens 1978
	alevin	F,M,T	S	100	---	ONNE03F	22.28		Servizi and Martens 1978
	alevin	F,M,T	S	110	---	ONNE04F	25.68		Servizi and Martens 1978
	alevin	F,M,T	S	130	---	ONNE05F	33.19		Servizi and Martens 1978
	fry	F,M,T	S	150	---	ONNE06F	42.32		Servizi and Martens 1978
	smolt, 5.5 g	F,M,T	S	210	---	ONNE07F	80.98		Servizi and Martens 1978
	smolt, 5.5 g	F,M,T	S	170	---	ONNE08F	53.26		Servizi and Martens 1978
	smolt, 5.5 g	F,M,T	S	190	---	ONNE09F	65.95		Servizi and Martens 1978
	smolt, 4,8 g	F,M,T	S	240	---	ONNE10F	104.3		Servizi and Martens 1978
Chinook salmon,	alevin, 0.05 g	F,M,T	C	26	---	ONTS01F	12.84	25.68	Chapman 1975, 1978
Oncorhynchus tshawytscha	swim-up, 0.23 g	F,M,T	C	19	---	ONTS02F	9.11		Chapman 1975, 1978
	parr, 9.6 cm, 11.58 g	F,M,T	C	38	---	ONTS03F	25.34		Chapman 1975, 1978
	smolt, 14.4 cm, 32.46	F,M,T	C	26	---	ONTS04F	17.95		Chapman 1975, 1978
	3 mo, 1.35 g	F,M,T,I	C	10.2	---	ONTS05F	17.68		Chapman and McCrady 1977
	3 mo, 1.35 g	F,M,T,I	C	24.1	---	ONTS06F	30.37		Chapman and McCrady 1977
	3 mo, 1.35 g	F,M,T,I	C	82.5	---	ONTS07F	33.95		Chapman and McCrady 1977
	3 mo, 1.35 g	F,M,T,I	C	128.4	---	ONTS08F	21.38		Chapman and McCrady 1977
	swim-up, 0.36-0.45 g	F,M,T,D	C	0	7.4	ONTS09F	35.81		Welsh et al. 2000
	swim-up, 0.36-0.45 g	F,M,T,D	C	0	12.5	ONTS10F	28.39		Welsh et al. 2000
	swim-up, 0.36-0.45 g	F,M,T,D	C	0	14.3	ONTS11F	31.17		Welsh et al. 2000
	swim-up, 0.36-0.45 g	F,M,T,D	C	0	18.3	ONTS12F	44.51		Welsh et al. 2000

Table 1a. Acute Toxicity of Copper to Freshwater Animals

Species[a]	Organism Age, Size, or Lifestage	Method[b]	Chemical[c]	Reported LC50 or EC50 (total µg/L)[d]	Reported LC50 or EC50 (Diss. µg/L)[e]	BLM Data Label	BLM Normalized LC50 or EC50 (µg/L)[f]	Species Mean Acute Value (µg/L)[g]	Reference
Bull trout, *Salvelinus confluentus*	0.130 g, 2.6 cm	F,M,T,D	C	228	---	SACO01F	75.20	72.36	Hansen et al. 2000
	0.555 g, 4.0 cm	F,M,T,D	C	207	---	SACO02F	69.33		Hansen et al. 2000
	0.774 g, 4.5 cm	F,M,T,D	C	66.6	---	SACO03F	77.73		Hansen et al. 2000
	1.520 g, 5.6 cm	F,M,T,D	C	50	---	SACO04F	66.12		Hansen et al. 2000
	1.160 g, 5.2 cm	F,M,T,D	C	89	---	SACO05F	74.05		Hansen et al. 2000
Chiselmouth, *Acrocheilus alutaceus*	4.6 cm, 1.25 g	F,M,T	C	143	---	ACAL01F	187.5	187.5	Andros and Garton 1980
Bonytail chub, *Gila elegans*	larval, 0.29 g	S,M,T	S	200	---	GIEL01S	65.62	65.62	Dwyer et al. 1995
Golden shiner, *Notemigonus crysoleucas*	---	F,M,T	C	84600	---	NOCR01F	101999	101999	Hartwell et al. 1989
Fathead minnow, *Pimephales promelas*	adult, 40 mm	S,M,T	S	310	---	PIPR01S	236.3	72.07	Birge et al. 1983
	adult, 40 mm	S,M,T	S	120	---	PIPR02S	95.02		Birge et al. 1983
	adult, 40 mm	S,M,T	S	390	---	PIPR03S	193.6		Birge et al. 1983; Benson & Birge
	---	S,M,T	C	55	---	PIPR04S	34.74		Carlson et al. 1986
	---	S,M,T	C	85	---	PIPR05S	63.41		Carlson et al. 1986
	<24 h	S,M,T	N	15	---	PIPR06S	11.54		Schubauer-Berigan et al. 1993
	<24 h	S,M,T	N	44	---	PIPR07S	18.53		Schubauer-Berigan et al. 1993
	<24 h	S,M,T	N	>200	---	PIPR08S	25.04		Schubauer-Berigan et al. 1993
	<24 h, 0.68 mg	S,M,T	S	4.82	---	PIPR09S	7.75		Welsh et al. 1993
	<24 h, 0.68 mg	S,M,T	S	8.2	---	PIPR10S	14.86		Welsh et al. 1993
	<24 h, 0.68 mg	S,M,T	S	31.57	---	PIPR11S	22.35		Welsh et al. 1993
	<24 h, 0.68 mg	S,M,T	S	21.06	---	PIPR12S	15.66		Welsh et al. 1993
	<24 h, 0.68 mg	S,M,T	S	35.97	---	PIPR13S	18.72		Welsh et al. 1993
	<24 h, 0.68 mg	S,M,T	S	59.83	---	PIPR14S	14.72		Welsh et al. 1993
	<24 h, 0.68 mg	S,M,T	S	4.83	---	PIPR15S	5.06		Welsh et al. 1993
	<24 h, 0.68 mg	S,M,T	S	70.28	---	PIPR16S	11.66		Welsh et al. 1993
	<24 h, 0.68 mg	S,M,T	S	83.59	---	PIPR17S	6.98		Welsh et al. 1993
	<24 h, 0.68 mg	S,M,T	S	182	---	PIPR18S	11.99		Welsh et al. 1993
	larval, 0.32 g	S,M,T	S	290	---	PIPR19S	76.77		Dwyer et al. 1995
	larval, 0.56 g	S,M,T	S	630	---	PIPR20S	165.4		Dwyer et al. 1995
	larval, 0.45 g	S,M,T	S	400	---	PIPR21S	107.6		Dwyer et al. 1995
	larval, 0.39 g	S,M,T	S	390	---	PIPR22S	169.2		Dwyer et al. 1995
	3.2-5.5 cm, 0.42-3.23	S,M,T	S	450	---	PIPR23S	161.2		Richards and Beitinger 1995
	2.8-5.1 cm, 0.30-2.38	S,M,T	S	297	---	PIPR24S	81.18		Richards and Beitinger 1995
	1.9-4.6 cm, 0.13-1.55	S,M,T	S	311	---	PIPR25S	70.03		Richards and Beitinger 1995
	3.0-4.8 cm, 0.23-1.36	S,M,T	S	513	---	PIPR26S	78.68		Richards and Beitinger 1995
	<24 h	S,M,T,D	S	62.23	53.96	PIPR27S	23.42		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	190.5	165.18	PIPR28S	72.39		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	68.58	59.46	PIPR29S	26.01		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	168.91	146.46	PIPR30S	74.50		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	94.62	82.04	PIPR31S	44.23		Erickson et al. 1996a,b

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Species[a]	Organism Age, Size, or Lifestage	Method[b]	Chemical[c]	Reported LC50 or EC50 (total µg/L)[d]	Reported LC50 or EC50 (Diss. µg/L)[e]	BLM Data Label	BLM Normalized LC50 or EC50 (µg/L)[f]	Species Mean Acute Value (µg/L)[g]	Reference
	<24 h	S,M,T,D	S	143.51	124.43	PIPR32S	91.55		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	120.65	103.76	PIPR33S	76.77		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	196.85	167.32	PIPR34S	100.2		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	133.35	120.02	PIPR35S	114.0		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	184.15	169.42	PIPR36S	192.6		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	304.8	268.22	PIPR37S	119.2		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	292.1	242.44	PIPR38S	161.1		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	133.35	113.35	PIPR39S	91.76		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	92.71	77.88	PIPR40S	66.17		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	152.4	128.02	PIPR41S	108.5		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	177.8	151.13	PIPR42S	133.0		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	203.2	166.62	PIPR43S	137.0		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	190.5	163.83	PIPR44S	125.8		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	196.85	157.48	PIPR45S	148.8		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	234.95	199.71	PIPR46S	161.2		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	146.05	128.52	PIPR47S	109.2		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	171.45	150.88	PIPR48S	129.0		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	152.4	131.06	PIPR49S	95.81		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	184.15	160.21	PIPR50S	107.2		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	203.2	182.88	PIPR51S	105.7		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	203.2	180.85	PIPR52S	85.58		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	203.2	176.78	PIPR53S	104.4		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	222.25	188.91	PIPR54S	119.3		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	146.05	125.60	PIPR55S	99.21		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	139.7	117.35	PIPR56S	78.65		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	139.7	114.55	PIPR57S	72.30		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	152.4	126.49	PIPR58S	76.77		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	203.2	172.72	PIPR59S	103.1		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	196.85	167.32	PIPR60S	91.87		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	266.7	226.70	PIPR61S	119.7		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	99.06	84.20	PIPR62S	127.2		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	111.13	97.79	PIPR63S	151.0		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	78.74	70.08	PIPR64S	103.9		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	92.71	81.58	PIPR65S	108.4		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	85.09	77.43	PIPR66S	93.19		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	123.19	110.87	PIPR67S	105.3		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	165.1	151.89	PIPR68S	93.38		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	190.5	175.26	PIPR69S	72.74		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	165.1	145.29	PIPR70S	122.1		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	127	111.76	PIPR71S	88.62		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	92.08	79.18	PIPR72S	52.68		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	66.68	60.01	PIPR73S	34.17		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	393.70	370.08	PIPR74S	156.7		Erickson et al. 1996a,b

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Species[a]	Organism Age, Size, or Lifestage	Method[b]	Chemical[c]	Reported LC50 or EC50 (total µg/L)[d]	Reported LC50 or EC50 (Diss. µg/L)[e]	BLM Data Label	BLM Normalized LC50 or EC50 (µg/L)[f]	Species Mean Acute Value (µg/L)[g]	Reference
	<24 h	S,M,T,D	S	317.50	292.10	PIPR75S	233.0		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	107.95	101.47	PIPR76S	153.7		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	67.95	62.51	PIPR77S	129.3		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	45.72	42.06	PIPR78S	108.4		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	177.80	172.47	PIPR79S	170.7		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	13.97	12.43	PIPR80S	25.34		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	304.80	271.27	PIPR81S	138.7		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	71.12	71.12	PIPR82S	97.64		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	83.82	79.63	PIPR83S	99.81		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	104.78	99.54	PIPR84S	105.8		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	139.70	132.72	PIPR85S	126.7		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	152.40	137.16	PIPR86S	106.1		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	260.35	182.25	PIPR87S	105.9		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	488.95	268.92	PIPR88S	112.4		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	203.20	188.98	PIPR89S	135.6		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	704.85	662.56	PIPR90S	172.0		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	952.50	904.88	PIPR91S	183.0		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	1244.60	995.68	PIPR92S	174.9		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	1485.90	891.54	PIPR93S	126.5		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	781.05	757.62	PIPR94S	170.0		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	476.25	404.81	PIPR95S	161.2		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	273.05	262.13	PIPR96S	175.3		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	22.23	20.45	PIPR97S	51.55		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	24.13	23.16	PIPR98S	57.82		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	36.83	34.99	PIPR99S	89.18		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	27.94	27.94	PIPR100S	69.87		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	26.67	26.67	PIPR101S	65.31		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	20.32	20.32	PIPR102S	44.85		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	26.67	26.67	PIPR103S	58.92		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	190.50	182.88	PIPR104S	134.8		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	109.86	96.67	PIPR105S	85.13		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	203.20	182.88	PIPR106S	121.76		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	209.55	190.69	PIPR107S	109.6		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	146.05	127.06	PIPR108S	94.04		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	165.10	148.59	PIPR109S	115.0		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	254.00	223.52	PIPR110S	122.7		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	311.15	283.15	PIPR111S	122.3		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	165.10	150.24	PIPR112S	98.55		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	920.75	644.53	PIPR113S	121.8		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	1073.15	697.55	PIPR114S	112.5		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	1003.30	752.48	PIPR115S	107.9		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	933.45	653.42	PIPR116S	116.9		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	742.95	646.37	PIPR117S	128.2		Erickson et al. 1996a,b

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	<24 h	S,M,T,D	S	1879.60	939.80	PIPR118S	111.3		Erickson et al. 1996a,b
	<24 h	S,M,T,D	S	266.70	253.37	PIPR119S	161.4		Erickson et al. 1996a,b
	---	F,M,T	S	114.00	---	PIPR120F	16.27		Lind et al. Manuscript (1978)
	---	F,M,T	S	121.00	---	PIPR121F	17.88		Lind et al. Manuscript (1978)
	---	F,M,T	S	88.50	---	PIPR122F	11.98		Lind et al. Manuscript (1978)
	---	F,M,T	S	436.00	---	PIPR123F	69.67		Lind et al. Manuscript (1978)
	---	F,M,T	S	516.00	---	PIPR124F	46.18		Lind et al. Manuscript (1978)
	---	F,M,T	S	1586.00	---	PIPR125F	61.17		Lind et al. Manuscript (1978)
	---	F,M,T	S	1129.00	---	PIPR126F	67.41		Lind et al. Manuscript (1978)
	---	F,M,T	S	550.00	---	PIPR127F	41.03		Lind et al. Manuscript (1978)
	---	F,M,T	S	1001.00	---	PIPR128F	31.96		Lind et al. Manuscript (1978)
	30 d, 0.15 g	F,M,T,D	N	96.00	88.32	PIPR129F	35.79		Spehar and Fiandt 1986
	<24 h	F,M,T,D	S	31.75	27.94	PIPR130F	7.72		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	117.48	105.73	PIPR131F	32.23		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	48.26	40.06	PIPR132F	18.97		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	73.03	64.26	PIPR133F	19.48		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	59.06	49.02	PIPR134F	18.47		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	78.74	67.72	PIPR135F	16.80		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	22.23	18.67	PIPR136F	12.29		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	6.99	6.15	PIPR137F	9.83		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	22.23	20.45	PIPR138F	16.03		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	107.32	93.36	PIPR139F	59.69		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	292.10	245.36	PIPR140F	4.33		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	81.28	72.34	PIPR141F	37.18		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	298.45	229.81	PIPR142F	3.79		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	241.30	195.45	PIPR143F	8.56		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	133.35	109.35	PIPR144F	8.64		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	93.98	78.00	PIPR145F	45.63		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	67.95	45.52	PIPR146F	21.06		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	4.76	4.38	PIPR147F	35.59		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	13.97	12.43	PIPR148F	40.38		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	29.85	26.86	PIPR149F	52.53		Erickson et al. 1996a,b
	<24 h	F,M,T,D	S	59.69	51.33	PIPR150F	51.59		Erickson et al. 1996a,b
Northern squawfish,	larval, 0.32 g	S,M,T	S	380	---	PTLU01S	92.13	138.2	Dwyer et al. 1995
Ptychocheilus oregonensis	larval, 0.34 g	S,M,T	S	480	---	PTLU02S	207.4		Dwyer et al. 1995

Table 1a. Acute Toxicity of Copper to Freshwater Animals

Species[a]	Organism Age, Size, or Lifestage	Method[b]	Chemical[c]	Reported LC50 or EC50 (total µg/L)[d]	Reported LC50 or EC50 (Diss. µg/L)[e]	BLM Data Label	BLM Normalized LC50 or EC50 (µg/L)[f]	Species Mean Acute Value (µg/L)[g]	Reference
Northern squawfish,	5.0 cm, 1.33 g	F,M,T	C	23	---	PTOR01F	15.23	13.15	Andros and Garton 1980
Ptychocheilus oregonensis	7.2 cm, 3.69 g	F,M,T	C	18	---	PTOR02F	11.36		Andros and Garton 1980
Razorback sucker,	larval, 0.31 g	S,M,T	S	220	---	XYTE01S	66.16	81.75	Dwyer et al. 1995
Xyrauchen texanus	larval, 0.32 g	S,M,T	S	340	---	XYTE02S	101.0		Dwyer et al. 1995
Gila topminnow, *Poeciliposis occidentalis*	2.72 cm, 0.219 g	S,M,T	S	160	---	POAC01S	58.32	58.32	Dwyer et al. 1999
Bluegill,	3.58 cm, 0.63 g	R,M,D	C	-	2200	LEMA01R	2026	1968	Blaylock et al. 1985
Lepomis macrochirus	12 cm, 35 g	F,M,T	S	1100	---	LEMA02F	1965		Benoit 1975
	2.8-6.8 cm	F,M,T	C	1000	---	LEMA03F	3512		Cairns et al. 1981
	3.58 cm, 0.63 g	F,M,D	C	-	1300	LEMA04F	1073		Blaylock et al. 1985
Fantail darter,	3.7 cm	S,M,T	S	330	---	ETFL01S	123.2	130.2	Lydy and Wissing 1988
Etheostoma flabellare	3.7 cm	S,M,T	S	341	---	ETFL02S	126.6		Lydy and Wissing 1988
	3.7 cm	S,M,T	S	373	---	ETFL03S	128.5		Lydy and Wissing 1988
	3.7 cm	S,M,T	S	392	---	ETFL04S	143.1		Lydy and Wissing 1988
Greenthroat darter, *Etheostoma lepidum*	2.26 cm, 0.133 g	S,M,T	S	260	---	ETLE01S	86.34	86.34	Dwyer et al. 1999
Johnny darter,	3.9 cm	S,M,T	S	493	---	ETNI01S	175.5	187.3	Lydy and Wissing 1988
Etheostoma nigrum	3.9 cm	S,M,T	S	483	---	ETNI02S	172.5		Lydy and Wissing 1988
	3.9 cm	S,M,T	S	602	---	ETNI03S	210.4		Lydy and Wissing 1988
	3.9 cm	S,M,T	S	548	---	ETNI04S	193.2		Lydy and Wissing 1988
Fountain darter, *Etheostoma rubrum*	2.02 cm, 0.062 g	S,M,T	S	60	---	ETRU01S	23.38	23.38	Dwyer et al. 1999
Boreal toad, *Bufo boreas*	tadpole, 0.012 g	S,M,T	S	120	---	BUBO01S	49.06	49.06	Dwyer et al. 1999

[a] Species appear in order taxonomically, with invertebrates listed first, fish, and an amphibian listed last. Species within each genus are ordered alphabetically. Within each species, tests are ordered by test method (static, renewal, flow-through) and date.

[b] S = static, R = renewal, F = flow-through, U = unmeasured, M = measured, T = exposure concentrations were measured as total copper, D = exposure concentrations were measured as dissolved copper.

[c] S = copper sulfate, N = copper nitrate, C = copper chloride.

[d] Values in this column are total copper LC50 or EC50 values as reported by the author.

[e] Values in this column are dissolved copper LC50 or EC50 values either reported by the author or if the author did not report a dissolved value then a conversion factor (CF) was applied to the total copper LC50 to estimate dissolved copper values.

[f] Normalization Chemistry

Temp	pH	Diss Cu	DOC	% HA	Ca	Mg	Na	K	SO4	Cl	HCO3	S
Deg C		ug/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
20.00	7.50	1.00E+00	5.00E-01	10.00	1.40E+01	1.21E+01	2.63E+01	2.10E+00	1.90E+00	8.14E+01	6.50E+01	3.00E-04

g Underlined LC50s or EC50s not used to derive SMAV because considered extreme value.