Site-Specific Chloride Water Quality Objectives N.E. British Columbia Wetland

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April 9, 2014

AECOM

(1) Typical Aquatic Receptors and Conceptual Model

(2) Protection Objectives: Ambient vs. Site-Specific

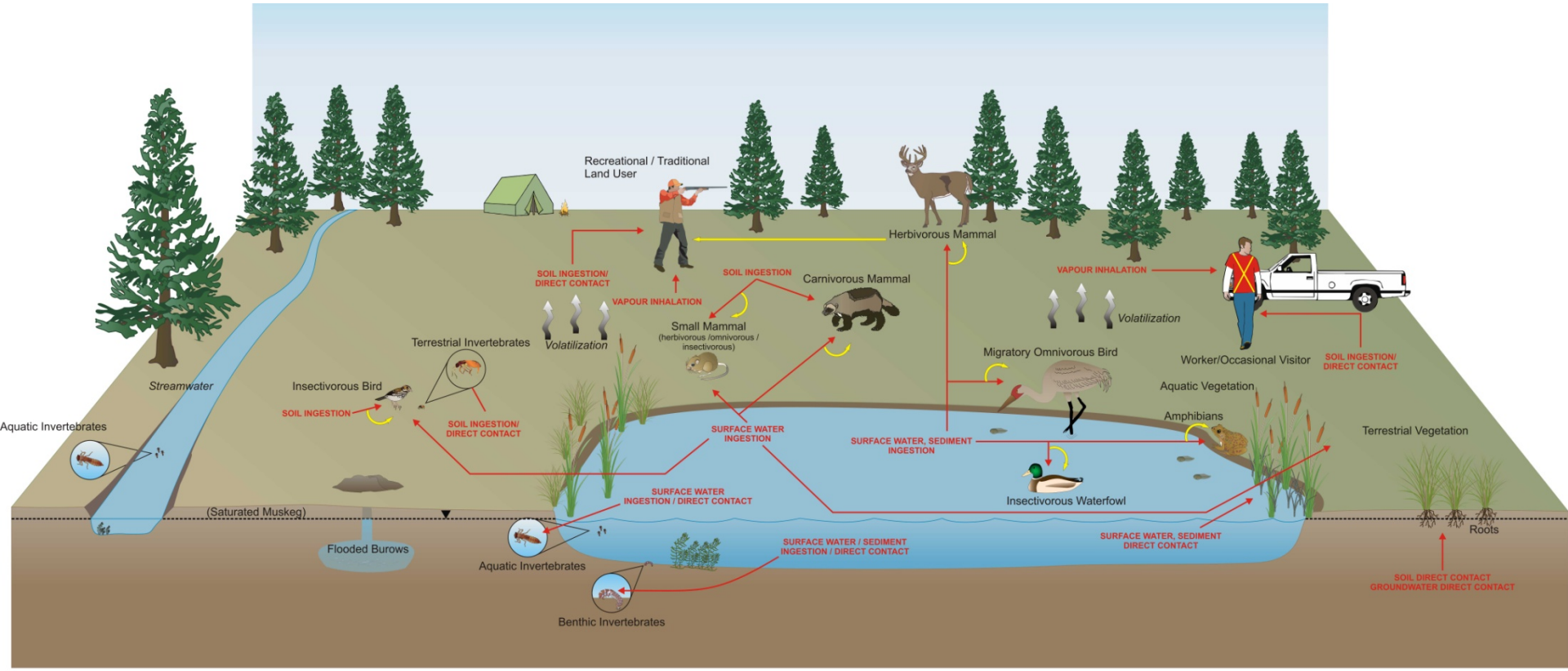
(3) AQUIRE Data, QA and Final Data Sets

(4) Statistical Models and Site-Specific Objective

Typical Aquatic Receptors

TAXON	Abundance
COELENTERATA (benthos)	+
ROTIFERA (zooplankton)	+++
TURBELLARIA (benthos)	+
OLIGOCHAETA (benthos)	++
CLADOCERA (zooplankton)	+++
OSTRACODA (epi-benthic)	++
COPEPODA (zooplankton)	+++
AMPHIPODA (epi-benthic)	+
ARACHNIDA (epi-benthic)	+
INSECTA (various)	++
GASTROPODA (benthos)	+

Conceptual Site Model & Aquatic Receptors



Dietary Component (Food Chain Uptake)

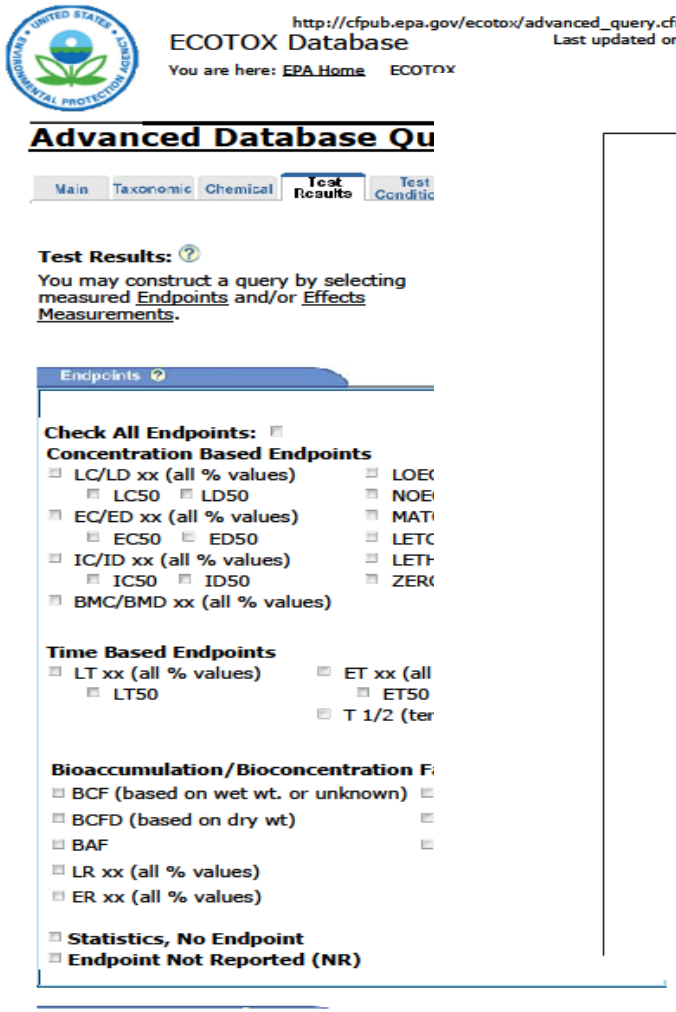
Direct Exposure Pathway

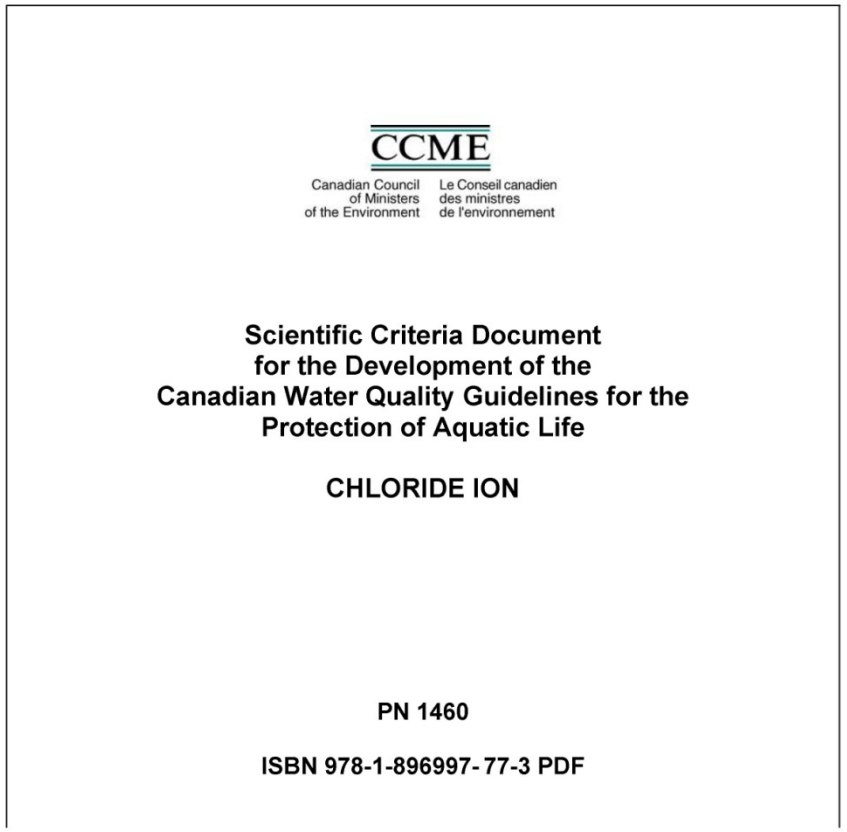
Protection Objectives: Site-Specific vs. Ambient

Factors	Provincial / Federal Ambient Guideline	Site-Specific Objective
Geographic Scope	Province or country wide water bodies from Bow River to farmers dugout	Boreal wetland unlikely to be directly connected to fish bearing waters
Receptors	Fish, invertebrates, algae, plants, invertebrates and amphibians including all possible protected sensitive species	Invertebrates, algae, plants and amphibians but without any Provincially or Federally protected species
Protection Goals	EC_{05} population level	EC_{20} population level
Endpoints	Single dataset: bias EC/ $IC10^{th}$ or 20^{th} percentile effects	Lethal dataset: $LC50^{th}$ Non-lethal dataset: EC/ $IC10^{th}$-50^{th} percentile effects

AQUIRE Database and Quality Assurance

AQUIRE Data Base





AQUIRE Output

Chemical Name	Species Scientific Name	Species Common Name	Species Group	Exposure Type	Chemical Analysis	Media Type	Test Location	ed Durati on Mean	d Duration Units (Days)	Endpoi nt	Effect	Effect Measurement	Conc 1 Mean (ug/L)	Conc 1 Units (ug/L)	Statistical Significance	Reference Number	Author	Title	Source
Sodium chloride (NaCl)	Ceriodaphnia dubia	Water Flea	Crustaceans; Standard Test Species	R	U	FW	LAB	7	d	IC50	REP	PROG	830800	ug/L	NA	11152	DeGraeve,G.M., J.D. Cooney, B.H. Marsh, T.L. Pollock, and N.G. Reichenbach	Variability in the Performance of the 7-D Ceriodaphnia dubia Survival and Reproduction Test: An Intra- and Interlaboratory Study	Environ. Toxicol. Chem.11(6): 851-866
Sodium chloride (NaCl)	Ceriodaphnia dubia	Water Flea	Crustaceans; Standard Test Species	R	U	FW	LAB	7	d	IC50	REP	PROG	595200	ug/L	NA	11152	DeGraeve,G.M., J.D. Cooney, B.H. Marsh, T.L. Pollock, and N.G. Reichenbach	Variability in the Performance of the 7-D Ceriodaphnia dubia Survival and Reproduction Test: An Intra- and Interlaboratory Study	Environ. Toxicol. Chem.11(6): 851-866
Sodium chloride (NaCl)	Daphnia pulex	Water Flea	Crustaceans; Standard Test Species	S	U	FW	LAB	1	d	EC50	ITX	IMBL	2043520.124	ug/L	NA	16385	Lilius,H., T. Hastbacka, and B. Isomaa	A Comparison of the Toxicity of 30 Reference Chemicals to Daphnia magna and Daphnia pulex	Environ. Toxicol. Chem.14(12): 2085-2088
Sodium chloride (NaCl)	Ceriodaphnia dubia	Water Flea	Crustaceans; Standard Test Species	S	U	FW	LAB	2	d	EC50	ITX	IMBL	1315981	ug/L	NA	20672	Warne,M.S.J., and A.D. Schifko	Toxicity of Laundry Detergent Components to a Freshwater Cladoceran and Their Contribution to Detergent Toxicity	Ecotoxicol. Environ. Saf.44(2): 196-206
Sodium chloride (NaCl)	Ceriodaphnia dubia	Water Flea	Crustaceans; Standard Test Species	R	M	FW	LAB	8	d	EC50	REP	PROG	1500000	ug/L	NA	45168	Cowgill,U.M., and D.P. Milazzo	The Response of the Three Brood Ceriodaphnia Test to Fifteen Formulations and Pure Compounds in Common Use	Arch. Environ. Contam. Toxicol.21(1): 35-40
Sodium chloride (NaCl)	Daphnia pulex	Water Flea	Crustaceans; Standard Test Species	R	M	FW	LAB	21	d	IC10	REP	FCND/PROG	368000	ug/L	NA	45826	Birge,W.J., J.A. Black, A.G. Westerman, T.M. Short, S.B. Taylor, D.M. Bruser, and E.D. Wallingford	Recommendations on Numerical Values for Regulating Iron and Chloride Concentrations for the Purpose of Protecting Warmwater Species of Aquatic Life in the Commonwealth of Kentucky	University of Kentucky, Lexington, KY:73 p.
Sodium chloride (NaCl)	Daphnia ambigua	Water Flea	Crustaceans	R	M	FW	LAB	10	d	EC50	REP	PROG	403000	ug/L	NA	71674	Harmon,S.M., W.L. Specht, and G.T. Chandler	A Comparison of the Daphnids Ceriodaphnia dubia and Daphnia ambigua for Their Utilization in Routine Toxicity Testing in the Southeastern United States	Arch. Environ. Contam. Toxicol.45(1): 79-85

Quality Assurance

Environmental Pollution 159 (2011) 1702–1708

Contents lists available at ScienceDirect

Environmental Pollution

journal homepage: www.elsevier.com/locate/envpol

Assessing the toxicity of sodium chloride to the glochidia of freshwater mussels: Implications for salinization of surface waters

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Freshwater mussel larvae were acutely sensitive to sodium chloride, such that chloride levels in some Canadian rivers may pose a threat to the survival of this early life stage.

ARTICLE INFO

Article history:
Received 26 August 2010
Received in revised form
7 December 2010
Accepted 24 February 2011

Keywords:
Freshwater mussels
Road salt
Chloride toxicity
Endangered species
Glochidia

ABSTRACT

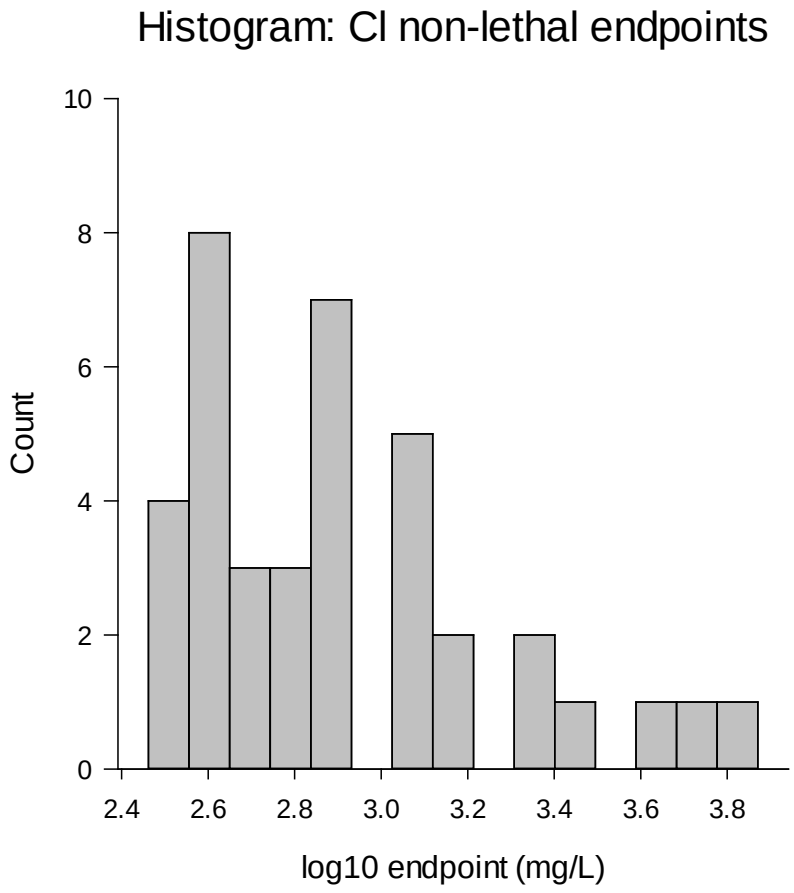
Chloride concentrations in surface waters have increased significantly, a rise attributed to road salt use. In Canada, this may be a concern for endangered freshwater mussels, many with ranges limited to southern Ontario, Canada's most road-dense region. The acute toxicity of NaCl was determined for glochidia, the mussel's larval stage. The 24 h EC50s of four (including two Canadian endangered) species ranged from 113–1430 mg Cl L^{-1} (reconstituted water, 100 mg $CaCO_3$ L^{-1}). To determine how mussels would respond to a chloride pulse, natural river water (hardness 278–322 mg $CaCO_3$ L^{-1}) was augmented with salt. *Lampsilis fasciola* glochidia were significantly less sensitive to salt in natural water (EC50s 1265–1559 mg Cl L^{-1}) than in reconstituted water (EC50 285 mg L^{-1}). Chloride data from mussel habitats revealed chloride reaches levels acutely toxic to glochidia (1300 mg L^{-1}). The increased salinization of freshwater could negatively impact freshwater mussels, including numerous species at risk.

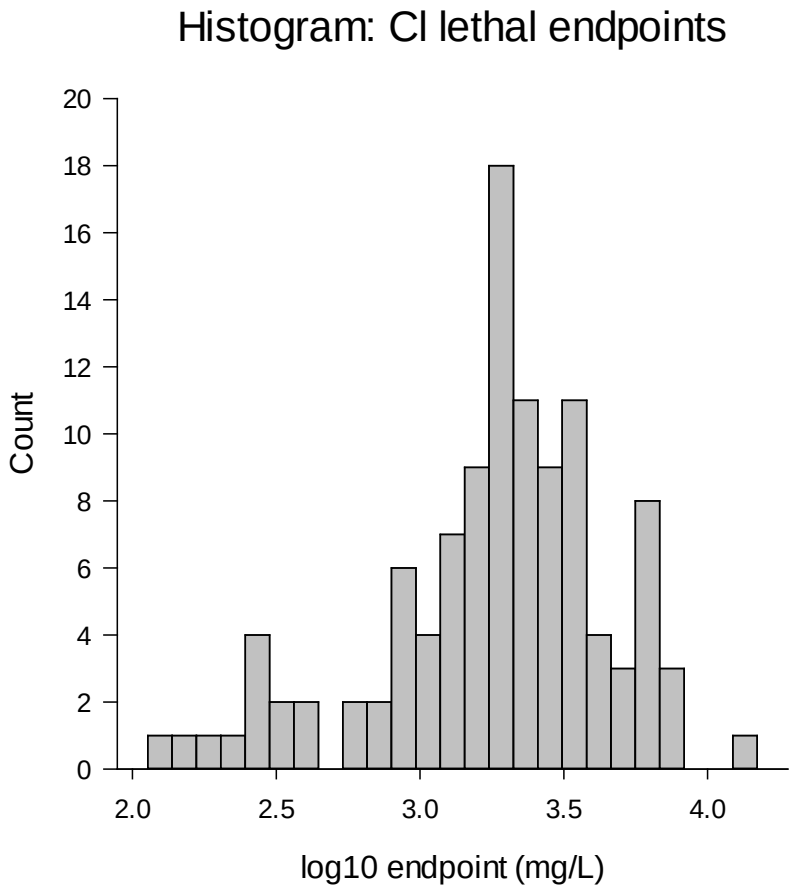
1. Introduction

The increase in the chloride concentration of North American surface waters over the past 30 years has been correlated with the increased application of de-icing salts on paved surfaces (Kaushal Kincaid and Findlay, 2009). Kaushal et al., (2005) suggested that baseline salinity in the Northeastern United States is approaching levels where significant changes in ecological communities and ecosystem function are expected. Recent studies suggest that such shifts may in fact already be occurring for some contaminant

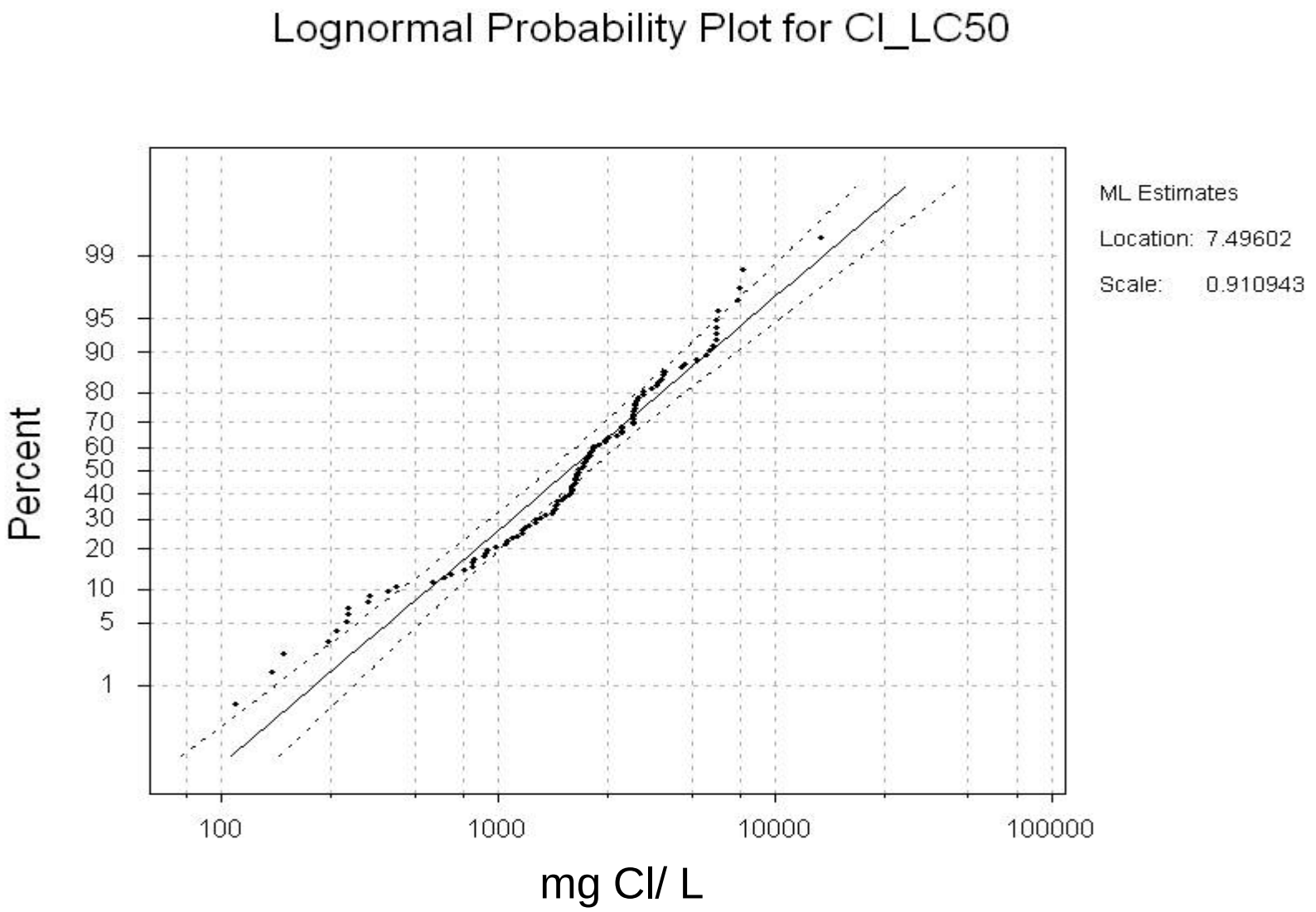
Statistical Models: Investigate Distribution

Histograms Evaluated: Neither Appears Normal

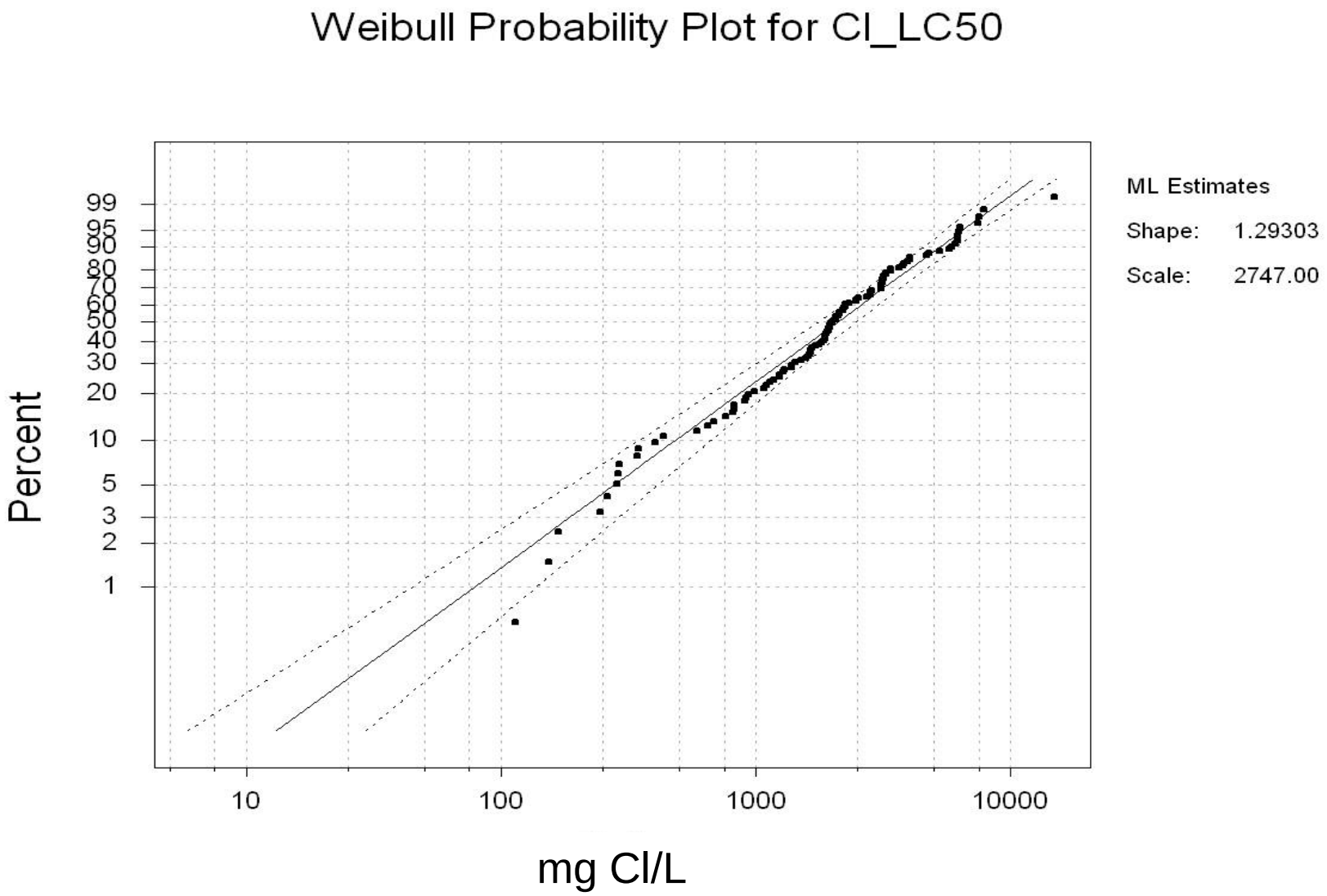




Model Fitting Lethality Endpoints – Normal ?



Model Fitting Lethality Endpoints – Weibull



Statistical Models:
Species Sensitivity Distribution

Statistical Models

$$F(x) = \frac{1}{2}\left[1 + \mathrm{erf}\left(\frac{x - \mu}{\sqrt{2\,x\,SD^2}}\right)\right]$$

Normal

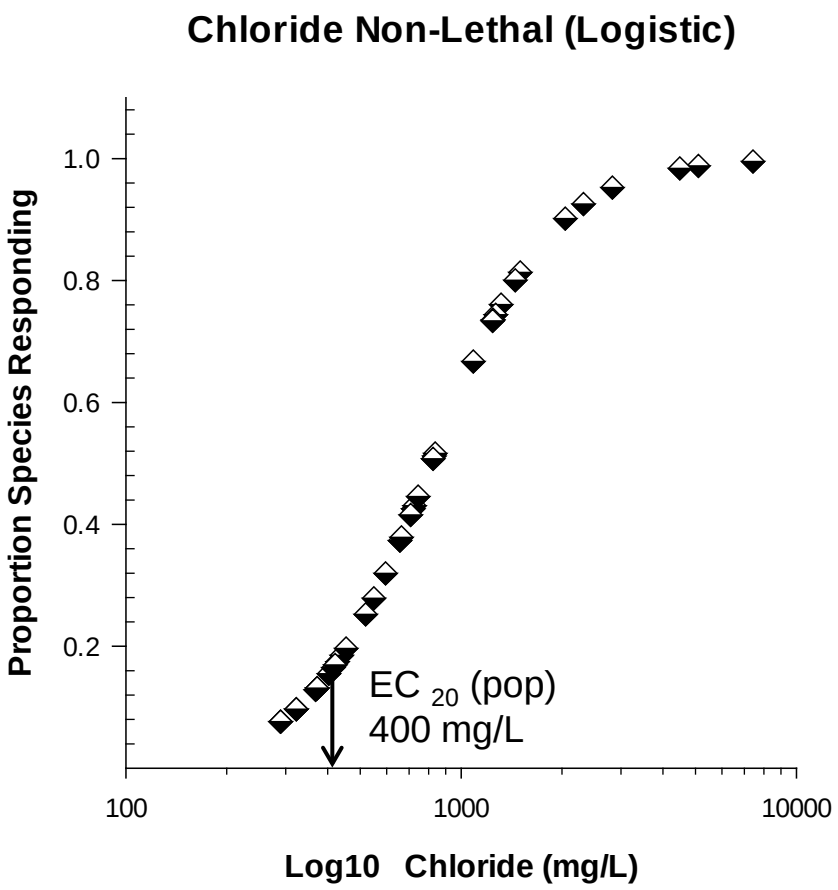
$$F(x) = \frac{1}{1 + e^{-\left(x - \mu / SD\right)}}$$

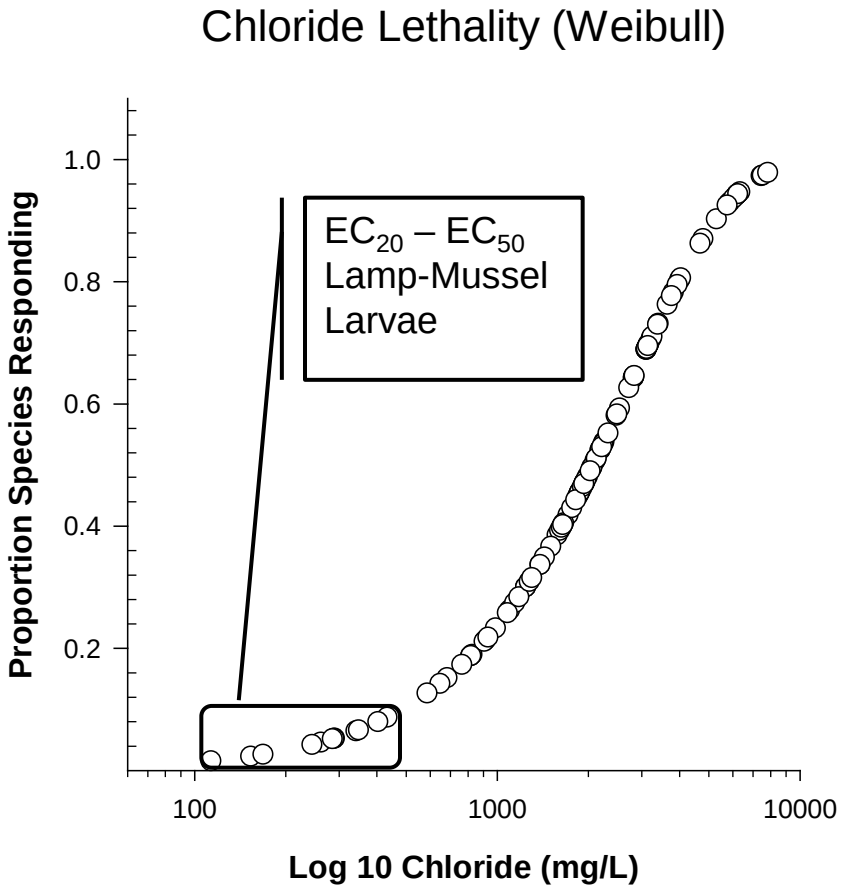
Logistic

$$F(x) = 1 - e^{\left(x/\lambda\right)^k}$$

Weibull

Cumulative Probability Distributions





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Chloride Threshold in Peatlands