

Assessing the Relative Toxicity of Different Road Salts and Effect of Temperature on Salinity Toxicity: LCx Values versus No-Effect Concentration (NEC) Values

Benjamin Moulding, Guillaume Kon Kam King, Mark Shenton, Jon Bray,

Susan Nichols, Ben Kefford

▶ To cite this version:

Benjamin Moulding, Guillaume Kon Kam King, Mark Shenton, Jon Bray, Susan Nichols, et al.. Assessing the Relative Toxicity of Different Road Salts and Effect of Temperature on Salinity Toxicity: LCx Values versus No-Effect Concentration (NEC) Values. Archives of Environmental Contamination and Toxicology, 2022, 82 (2), pp.281-293. 10.1007/s00244-021-00908-1. hal-03799365

HAL Id: hal-03799365 https://hal.science/hal-03799365v1

Submitted on 23 Jul 2024

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers. L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Preprints are preliminary reports that have not undergone peer review. They should not be considered conclusive, used to inform clinical practice, or referenced by the media as validated information.

Assessing the Relative Toxicity of Different Road Salts and Effect of Temperature on Salinity Toxicity: LCx Values vs. No Effect Concentration (NEC) Values

Benjamin John Gray Moulding (bjgm@live.com) University of Canberra https://orcid.org/0000-0002-5548-1070

Research Article

Keywords: toxicity, Colobruscoides giganteus, toxicokinetic-toxicodynamic, mayflies

Posted Date: June 8th, 2021

DOI: https://doi.org/10.21203/rs.3.rs-580126/v1

License: (a) This work is licensed under a Creative Commons Attribution 4.0 International License. Read Full License

Version of Record: A version of this preprint was published at Archives of Environmental Contamination and Toxicology on January 29th, 2022. See the published version at https://doi.org/10.1007/s00244-021-00908-1.

Abstract

Freshwater biota are at risk globally from increasing salinity, including increases from deicing salts in cold regions. A variety of metrics of toxicity are used when estimating the toxicity of substances and comparing the toxicity between substances. However, the implications of using different metrics is not widely appreciated. Using the mayfly Colobruscoides giganteus (Ephemeroptera: Colobruscoidea) we compare the toxicity of seven different salts where toxicity was estimated using two metrics 1) the no effect concentrations (NEC) and 2) the lethal concentrations for 10, 25 and 50% of the test populations (LC_x). The LC_x values were estimated using two different models, the classic log-logistic model and the newer toxicokinetic-toxicodynamic (TKTD) model. We also compare the toxicity of two salts (NaCl and CaCl₂) for *C. giganteus* at water temperatures of 4°C, 7°C and 15°C using the same metrics of toxicity. Our motivation for using a mayfly to assess salinity toxicity was because mayflies are generally salt sensitive, are ecologically important and are common in Australian (sub-)alpine streams. Considering 144-hour LC_x values, we found toxicity differed between various salts, i.e., the lowest 144-hour LC50 (8 mS/cm) for a salt used by a ski resort was half that of the highest 144-hour LC₅₀ from artificial marine salts and CaCl2 applied to roads (16mS/cm). 144-hour LC₅₀ results at 7°C showed that analytical grade NaCl was significantly more toxic (7.3mS/cm) compared to analytical grade CaCl₂ (12.5mS/cm). Yet for NEC values, there were comparably fewer differences in toxicity between salts and none between the same salts at different temperatures. We conclude that LC_x values are better suited to compare difference in toxicity between substances or between the same substance at different test temperatures, while NEC values are better suited to estimating concentrations of substances that have no effect to the test species and endpoint measured under laboratory conditions.

Full Text

This preprint is available for download as a PDF.

Figures



Classical (log-logistical) modeled lethal concentrations for x% of the test population or LCx (mS/cm) values for 7 different salts at 7°C \pm 1°C showing 5 different exposure periods (from left to right 24, 48, 72, 96, 120 and 144 hours); x= LCx 10, 25, 50 (from left to right). Median estiamte indicated by hrozontal line within box, 95% credibility intervals indicated by boxes. The y-axis is curtailed at 20 mS/cm and in those esimates without a median plotted, the upper 95% credibility interval continues to infinity. A full listing of all LCx estiamtes shown here is given in Suplemntary Table S1.



TKDT modelled lethal concentrations for x% of the test population or LCx (mS/cm) values for seven different salts at 7°C \pm 1°C showing six exposure periods (from left to right 24, 48, 72, 96, 120 and 144 hours); x= LCx 10, 25, 50 (from left to right). Median indicated by horizontal line within box, 95% credibility intervals indicated by boxes. A full listing of all LCx estimates shown here is given in Supplementary Table S2. See also Supplementary Figure S3.



No observed effect concentrations or NECs (mS/cm) values for seven different salts at 7°C ± 1°C using the TKDT model. Median indicated by error bars; 95% credibility intervals indicated by boxes. A full listing of all NEC estiamtes shown here is given in Supplementary Table S3.



Figure 4

Classical (log-logistical) modelled lethal concentrations for x% of the test population or LCx values (mS/cm) to analytical grade CaCl2 and NaCl and temperature (4°C, 7°C, 15°C). The multiple estimates for each x represent estimates (from left to right 24, 48, 72, 96, 120 and 144 hours). x= LCx 10, 25, 50 (from left to right). Median indicated by the horizontal line within box, 95% credibility intervals indicated by boxes. The y-axis is curtailed at 17 mS/cm and in those estimates without a median plotted, the upper 95% credibility interval continues to infinity. A full listing of all LCx estiamtes shown here is given in Suplemntary Table S3.



Log scale TKDT modelled lethal concentrations for x% of the test population or LCx values (mS/cm) to analytical grade CaCl2 and NaCl and temperature (4°C, 7°C, 15°C). The multiple estimates for each x represent (from left to right 24, 48, 72, 96, 120 and 144 hours. x= LCx 10, 25, 50 (from left to right). Median indicated by error bars; 95% credibility intervals indicated by boxes. A full listing of all LCx estiamtes shown here is given in Suplemntary Table S4.See also Supplementary Figure S4.



No observed effect concentrations or NECs (mS/cm) values for NaCl and CaCl2 for temperature ranges (4°C,7°C,15°C); median indicated by error bars, 95% credibility intervals indicated by boxes.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

• SupplementaryMaterialLCxNEC210528BK.docx