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TO: Idaho Department of Environmental Quality

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SUBJECT: Human health water quality criteria rulemaking for arsenic

As an independent, non-profit research institute that focuses on environmental topics of interest to the forest products industry, NCASI appreciates the opportunity to comment on the current rulemaking being conducted by the Idaho Department of Environmental Quality (IDEQ) for arsenic human health water quality criteria (HHWQC) to protect recreation and domestic water supply designated uses.

NCASI does not offer policy perspectives on scientific issues and therefore chooses to refrain from making suggestions for implementation guidance requested by IDEQ during the latest rulemaking meeting (IDEQ 2021). However, NCASI would like to take this opportunity to offer a peer review of the recent literature review and regression analyses presented by ARCADIS during the April 22, 2021 rulemaking meeting (Arcadis 2021).

Review of ARCADIS Analysis, "Further Evaluation of IDEQ 2019 Paired Fish and Surface Water Arsenic Data," and Feedback for IDEQ

Overview

The presenters sought to better understand the lack of a statistical relationship between Idaho's 2019 data paired fish tissue and surface water concentration data for arsenic and to determine whether these findings were consistent with other studies. Arcadis' literature review revealed that other field studies – notably, the review by Williams et al. (2006) – showed that the 2019 Idaho data are consistent with trends found in the literature, and that arsenic concentrations in fish tissue are not statistically related to arsenic concentrations in natural freshwaters.

In addition, inorganic arsenic (iAs) was found to be "biodiluted" across the food web in natural environments, with higher trophic levels having lower iAs concentrations than organisms lower in the food web. This pattern has been noted in field studies in Idaho (Dovick et al. 2015) and using stable isotope analysis (Revenga et al. 2012), and others. These results are said to conflict with findings from laboratory settings that neglect food web dynamics. The authors also suggested that metabolic transformation of iAs to organic As in fish tissue (i.e., bioregulation) may explain why organic As is primarily found in fish tissue in the Idaho data, citing recent studies from Ciardullo et al. (2008, 2010), Pei et al. (2019), and Cui et al. (2021).

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Multivariate regression analyses using the 2019 Idaho fish data were presented, and only fish weight was found to be a predictor of fish tissue As concentration (and not basin [location], species, feeding guild, tissue total As, surface water total As, or surface water iAs). The Bridgelip Sucker was an exception to the pattern and this was explained as attributable to this species' relatively uncommon feeding behavior during maturation wherein they feed preferentially on higher trophic level organisms as small/young fish (insectivores) than as adult fish (herbivores). The authors concluded that iAs concentrations are lower in higher trophic level consumers, as noted in the literature review, and as fish body weight increases.

Feedback

The literature review and regression results summarized above are informative for the rulemaking process and should be included as part of IDEQ's technical support documents that explain the rationale for a fish tissue criterion for recreational use protection. Ultimately, all presented hypotheses can be further confirmed with additional data collection, and therefore a publicly available database for fish tissue and water concentration measurements should be created and maintained as part of the IDEQ's proposed implementation plan.

A review by USEPA (2003) was notably missing from Arcadis' literature review, although individual studies contained within EPA's review were included. While dated relative to most of the literature cited in the Arcadis report, USEPA (2003) presented the latest collection of literature recognized by EPA for assessing bioaccumulation and recommendations for producing human health water quality criteria for arsenic. In particular, USEPA (2003) recognizes that "[a]rsenic, and/or its metabolites, is a chemical that bioaccumulates in tissues of aquatic organisms but does not biomagnify in the aquatic food chain (Chen and Folt 2000, Maeda et al. 1990, Mason et al. 2000, Spehar et al. 1980, Wagemann et al. 1978, Woolson 1975)." Arcadis' literature review confirms these early studies, highlighting more recent studies (e.g., Chetalat et al. 2019) using multiple methods (e.g., the isotope analysis by Revenga et al. [2012]) and a local, Idaho-specific study (Dovick et al. 2015) that evidenced biodilution.

USEPA (2003) also suggests that organic arsenic represents 80-90% of arsenic found in edible portions of marine fish and that in edible portions of freshwater fish, "there is evidence that organic arsenic may be as prevalent (Kaise et al. 1987; field-based study) or considerably less (Maeda et al. 1990, 1992, 1993; Suhendrayatna et al. 2001, 2002a,b; laboratory-based studies)" than inorganic arsenic. The assertion that laboratory studies neglect food web dynamics and, therefore, fail to accurately capture the relative abundance of organic vs. inorganic arsenic in natural waters was presented during the rulemaking meeting, along with updated evidence that point towards higher percentages of organic arsenic in freshwater fish (Ciardullo et al. 2008, 2010; Pei et al. 2019; and Cui et al. 2021). These represent important additions that add to the weight-of-evidence previously considered by EPA (2003).

Finally, when possible and as more data become available, data should be aggregated to better inform the multivariate regression analyses presented. For example, overlaying the data presented by the studies included in Williams et al. (2006) with current (2019) and previous IDEQ data (e.g., from 2008) could fully demonstrate the range of available measurements and the lack of a statistical relationship between fish tissue and water column concentrations. It is likely this information was not highlighted because it has been presented extensively in previous rulemaking meetings. However, compiling and publicly sharing these data, potentially as part of the comprehensive database mentioned above, will allow the consistency of trends to be evaluated using the full dataset, which may be overlooked with a more piecemeal analysis approach that only includes the most recently obtained data.

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