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CC: Carmen Chaparro, Acting Section Chief, Environmental Health Section

SUBJ: EVALUATION OF LEAD CONCENTRATIONS IN BLUE CRABS FROM THE MILL RIVER

DATE: March 26, 2024

This Letter Health Consultation (LHC) documents our evaluation of lead concentrations in blue crab tissue from the Mill River in Fairfield, Connecticut. Blue crab tissue analysis data in this LHC was obtained from Connecticut Department of Energy and Environmental Protection (CTDEEP).

This document also details the rationale for site-specific target lead concentrations for finfish and shellfish based on an updated interim reference level (IRL) of 2.2 µg/day for children (FDA 2023).

Background and Statement of Issues

The Mill River is located in Fairfield County, Connecticut. The river begins along the Easton-Monroe town boundary and flows sound through Easton and then Fairfield, before emptying into Southport Harbor, and ultimately, the Long Island Sound. Lead was discharged into the lower Mill River by the former Exide Battery Manufacturing Plant while it was operating between 1950 and 1981. A Connecticut Department of Public Health (CTDPH) evaluation of blue crab tissue results from the Mill River from 1999-2000 confirmed that lead levels were elevated enough to warrant a 'Do Not Eat' consumption advisory. A multi-decade remediation was conducted in an effort to remove lead-contaminated sediments from the Mill River. Lead remediation activities in the Mill River were completed in 2020 and blue crabs were subsequently sampled in 2022 and analyzed for lead to observe whether lead concentrations had decreased enough to allow safe consumption (Lally 2023).The

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Fisheries Division and the Remediation Division at CTDEEP requested that CTDPH evaluate lead data from blue crab tissue (collected in 2022) from the Mill River. This LHC documents the data evaluation process for the Mill River in Fairfield, CT.

Health Comparison Values and Fish Contaminant Levels

Previous Site-Specific Target Concentration for Lead

In the early 2000s, CTDPH derived a site-specific target concentration of 0.1 ppm for blue crabs in the Mill River (background area average = 0.05 ppm with impacted section's average ranging up to 1.5 ppm). This target concentration was clearly above background and is associated with 2.54 µg/day of additional lead ingestion assuming two 3 oz meals/week. This lead exposure (2.54 µg/day) is approximately equal to the estimated dietary contribution of lead from background sources in the lead Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK) model. When this additional dietary source was put into the previous version of the IEUBK model in 2012 at a 50% dietary uptake fraction, the model results showed 0.6% of children above 10 µg/deciliter (dL) and 15.3% above 5 µg/dL. Given the concerns regarding low dose neurotoxic effects of lead, CTDPH's preferred target was to maintain the vast majority of children (e.g., 95%) below 5 µg/dL rather than 10 µg/dL. The blue crab target concentration of 0.1 ppm would yield an increase of only 5% more children experiencing blood lead over 5 µg/dL relative to the baseline model since the baseline model is already associated with 10% of children above 5 µg/dL (Ginsberg 2012).

Updated Site-Specific Target Concentration for Lead

Interim Reference Level Rationale

No safe level of lead exposure has been identified for protecting children's health. The United States Food and Drug Administration (FDA) developed IRLs for dietary lead to replace the FDA's provisional tolerable daily intakes (PTTDIs), which had been developed in the early 1990s. The FDA updated the IRLs in 2022 using the Centers for Disease Control and Prevention (CDC) updated blood level reference value (BLRV) of 3.5 µg/dL and dietary conversion factors calculated by the United States Environmental Protection Agency (US EPA) to derive an **IRL of 2.2 µg/day for children.** (Flannery and Middleton 2022 and HHS 2023).

The IRL is linked to a biological marker of exposure (blood lead levels) and represents the dietary lead needed to achieve a blood lead level 10 times lower than that associated with CDC's BLRV. The CDC BLRV is a screening tool used to identify children who have higher levels of lead exposure as compared with most other children. The IRL is the maximum daily dietary intake of lead from food that corresponds to the CDC's BLRV of 3.5 µg/dL, with an additional 10x safety factor applied. The IRL serves as a valuable benchmark in evaluating the potential for adverse effects of dietary lead even though no safe level of lead exposure has been identified for children's health. The FDA's primary focus was on neurodevelopmental effects from lead exposure, as toxicological literature indicated that these are the most sensitive adverse effects from lead and consistently occur at very low blood lead levels (HHS 2023).

Derivation of Consumption Limits

Connecticut, like most states and tribal governments, develops risk-based fish consumption guidance following the *US EPA Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories Volume 2 Risk Assessment and Fish Consumption Limits (USEPA, 2000).* The method uses species-specific data on concentrations of a contaminant in fish tissue to determine how often it is safe to eat a particular finfish or shellfish species.

The maximum number of recommended meals of fish per month is calculated using a health-based reference dose (RfD)[1] and the measured concentration of contaminant in micrograms per gram (µg/g) using a form of the equation below:

$$\#Meals/month = \frac{RfD\ (\mu g/kg/\text{-}day) \times 17\ kg_{bw} \times 30.44\ days/month}{Concentration\ in\ fish\ (\mu g/g) \times 85.0486\ g_{fish/\ meal}}$$

Where:

RfD= (2.2 µg/day)/17 kg=0.129 µg/kg/day
µg/kg/-day= micrograms per kilogram per day
bw= body weight, child
g fish/meal= grams of fish per meal, child

Body Weight and Meal Size

When deriving a consumption limit for lead exposure, Connecticut uses the US EPA's 2011 guidance which recommends an average fish meal size of 85.0486 grams (3 ounces) for an 17 kg for a child, aged 2-<6 years old (USEPA 2011 and ATSDR 2023). CTDPH considers more than 8 fish meals per month or 2 fish meals per week, 'unlimited consumption.'

Using a rearranged form of the equation above and the CTDPH reference dose of 0.129 µg/kg/day, a body weight of 17 kg and an assumed meal size of 85.0486 grams, CTDPH has derived an updated site-specific target concentration for lead of 0.1 ppm for the Mill River. The site-specific target concentration is protective of young children who eat more than 2 fish meals per week (approximately 8 meals per month). This updated site-specific target concentration for lead is equivalent to the previous site-specific target concentration for lead that was derived in the early 2000s.

Fish Contaminant Levels

A total of 37 Atlantic blue crabs were collected for analysis in August 2022 in two Project Areas (designated as II and III) of the Mill River (Lally 2023). Twenty-three blue crabs were collected from Project Area II (Western Shore of Mill River upstream of Route 1 and downstream of the former Exide location), and 14 blue crabs were collected from Project Area III (upstream side of Harbor Road tide dam). In Project Area II, three composite samples each consisting of 6-8 individual blue crabs were analyzed for lead levels. In Project Area III, two composite samples each consisting of 7 individual blue crabs were analyzed for lead levels. As shown in Table 1, average lead levels for blue crabmeat for Project Areas II and III were 0.51 and 0.029 ppm while average crab tomalley (hepatopancreas) levels were higher at 0.342 and 0.14 ppm, respectively[2]. It is important to note that during 1999-2000 blue crab sampling event, blue crabs from Project Area II had the highest lead levels in the Mill River at 2.5 ppm.

[1]Since there is no safe level for lead, a health-based RfD has not been developed by any federal agencies. We followed the aforementioned FDA approach, and used the IRL in place of an RfD.

[2]Since there was a sufficient number of blue crab samples, CT DPH used the average lead concentration (instead of a 95% Upper Confidence Limit) found in the blue crab results to estimate whether the site-specific target concentration for lead has been exceeded in either Project Areas of the Mill River.

Table 1. Lead Concentrations in Blue Crabs Collected in August 2022 from the Mill River.

Project Area	Sample Size	Lead Range Level (Tomalley)(ppm*)	Mean Lead Level (Tomalley) (ppm)	Lead Range Level (Muscle)(ppm)	Mean Lead Level (Muscle)(ppm)
II	23	0.185-0.652	0.342	0.028-0.095	0.051
III	14	0.131-0.148	0.140	0.021-0.037	0.029

*parts per million

Discussion

Exposure Pathway Analysis

To determine if community members are exposed to lead through contaminated blue crabs in the Mill River, CTDPH evaluated the environmental and human components that lead to human exposure. CTDPH evaluated the blue crab tissue data and considered how people may be exposed to lead in the blue crabs. Lead was the only contaminant of concern in the blue crabs based on the site characterization of the Mill River (Lally 2023). The only possible complete pathway of exposure is via ingestion (eating the blue crabs). An exposure pathway consists of five elements (ATSDR 2022):

1. A source of contamination;
2. Transport through an environmental medium;
3. A point of exposure;
4. A route of human exposure; and
5. A receptor population.

ATSDR categorizes an exposure pathway as either completed, potential, or eliminated. In a completed pathway, all five elements exist and indicate that exposure to a contaminant has occurred in the past, is occurring, or will occur in the future. In a potential exposure pathway, at least one of the five elements has not been confirmed, but it may exist. Exposure to a contaminant may have occurred in the past, may be occurring, or may occur in the future. An exposure pathway can be eliminated if at least one of the five elements is missing and will never be present (ATSDR 2022).

Environmental data showed that blue crabs from the Mill River were contaminated with lead. Individuals who catch and eat blue crabs in these water bodies would likely be exposed to lead in the blue crabs. In addition, their families and friends would also be exposed to lead if they eat the blue crabs.

Public Health Implications for Adults and Children and Conclusion

When determining the public health implications of exposure to hazardous contaminants, CTDPH considers how people might come into contact with contaminants and compares contaminant concentrations with health protective levels. When contaminant levels are below health-based comparison values, health impacts from exposure to those levels are unlikely. Contaminant levels exceeding comparison values do not indicate that health impacts are likely, but instead warrant further investigation. In this health consultation, CTDPH used the updated site-specific target concentration for lead that is derived in this document. Ingestion of blue crab

tomalley and crab meat from the Mill River which contain lead is a complete exposure pathway and is evaluated in this health consultation.

Since blue crab meat does not exceed the updated site-specific target concentration for lead, CTDPH has concluded that a consumption advisory is no longer necessary to protect public health. However, since lead levels in blue crab tomalley exceed the updated site-specific target concentration for lead, CTDPH has decided to issue a "Do not eat' advisory for blue crab tomalley.

CTDPH has decided to remove the previous advisory of 'Do not eat' for blue crab meat for the following reasons:

1. One round of blue crab sampling data has indicated decreased levels of lead contamination in this waterbody. Lead levels in blue crab meat sampled from this waterbody have decreased significantly over time following remediation activities.
2. Average lead levels in blue crab meat from impacted areas of the Mill River are now below the updated site-specific target lead concentration of 0.1 ppm which was derived using the FDA IRL of 2.2 µg/day and the current CDC BLRV of 3.5 µg/dL which is protective of young children eating more than 2 fish meals/week and a meal size of 3 ounces.
3. Remedial activities have restored impacted areas of the Mill River such that lead levels in blue crab meat are at or below background levels (0.05 ppm) from unimpacted areas of the Mill River.

CTDPH has decided to issue an advisory of 'Do not eat' for blue crab tomalley from the Mill River for the following reasons:

1. Lead levels in blue crab tomalley sampled from this waterbody have decreased over time following remediation activities. However, average lead levels in blue crab tomalley from both Project Areas exceed the updated site-specific target lead concentration. In addition, even though average lead levels in tomalley from both Project Areas only exceed the site-specific target lead concentration by a few fold, and some limited consumption could be justified, CT DPH is making a risk management decision to recommend no consumption of crab tomalley in order to maintain consistency with the 'Do not eat' advisory for lobster tomalley from Long Island Sound.

It is important to note that there is a statewide fish consumption advisory based on mercury concentrations on all fresh waterbodies of 'one fish meal per week' for the general population and 'one fish meal per month' for the high risk population which includes pregnant women, women planning on becoming pregnant, breastfeeding women, and children under 6 years old.

Recommendations

1. CTDEEP Fisheries Division should continue to work with CTDPH to educate fishing populations about the statewide freshwater fish consumption advisory which includes the Mill River.

2. The Fairfield Health Department should remove the 'Do Not Eat' advisory signs on the Mill River.

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