Corrigendum

Corrigendum to “Regional variations and drivers of mercury and selenium concentrations in Steller sea lions” [Sci. Total Environ. 744 (2020) 140787]

L.D. Rea a,b,⁎, J.M. Castellini c, J.P. Avery a, B.S. Fadely d, V.N. Burkanov d,e, M.J. Rehberg b, T.M. O’Hara c,f

a Institute of Northern Engineering, Water and Environmental Research Center, University of Alaska Fairbanks, Fairbanks, AK 99775, USA
b Alaska Department of Fish and Game, Division of Wildlife Conservation, Anchorage, AK 99518, USA
c Department of Veterinary Medicine, College of Natural Sciences and Mathematics, University of Alaska Fairbanks, Fairbanks, AK 99775, USA
d Marine Mammal Laboratory, Alaska Fisheries Science Center, National Marine Fisheries Service, NOAA, Seattle, WA 98115, USA
e Kamchatka Branch of the Pacific Geographical Institute, Far East Branch of Russian Academy of Sciences, 6 Partizanskaya Street, Petropavlovsk-Kamchatsky 683000, Russia
f Veterinary Integrative Biosciences, College of Veterinary Medicine & Biomedical Sciences, Texas A&M University, College Station, TX 77843, USA

The authors regret that the printed version of the above article contained an omission of detail regarding methods. The correct and final version follows. The authors would like to apologise for any inconvenience caused.

In our original submission we included analysis of whole blood [TSe] and molar TSe:THg collected from Steller sea lion pups (SSL) over several years (2011–2015) from a number of rookeries from the Central Gulf of Alaska and the Eastern, Central, and Western Aleutian Islands (EAI, CAI, and WAI, respectively). The chemical and data analyses were conducted in batches over several years. Unfortunately, when the manuscript was written we unintentionally overlooked that we had applied a correction factor to some data when describing the methods. We present the following addendum to the manuscript to correct that omission and so the data can be understood within that context. We also present further analysis, removing all adjusted data, to confirm our original conclusions with respect to regional differences in SSL whole blood [TSe] and molar TSe:THg.

Samples were analyzed for [TSe] as described in the original manuscript and in series of runs over several years (e.g., collection year 2011, 6 runs of whole blood samples). Equipment issues resulted in some sets of runs with relatively low, but consistent, percent recovery for standard reference materials and matrix spikes. Data were normalized relative to mean blank spike recovery for a series of runs as reduced blank spike recovery was generally accompanied by similarly reduced reference material and matrix spike recovery. When the mean blank spike recovery values from a related series of runs were between 90 and 110% no adjustment was made to individual values within that series. When mean blank spike recovery values were < 90% for a related series of runs, a correction factor was calculated to adjust the mean blank spike to approximately 96%, similar to mean blank spike values from runs in 2015 (93.4 ± 2.5%). The correction factor was applied to individual whole blood and reference material (e.g., seronorm) measurements within a given series:

Correction Factor = Series Mean Blank Spike Recovery / 96

Adjusted Sample [TSe] = Sample [TSe] / Correction Factor

This approach resulted in similar QA/QC for reference materials and matrix spikes across different series of runs without trying to optimize each individual run, thus maintaining expected inter-run variability. Correction factors applied were 0.83 (2011), 0.79 (2012) and 0.75 (some 2013, 2014).

Data that included a correction factor would not have been included in the original statistical analyses without such adjustment as recoveries were too low to allow direct comparison. As the application of a correction factor was not reviewed as part of the original submission we have re-examined the data eliminating runs for which a correction factor was applied.

Removing adjusted data, while reducing the sample size and number of rookeries included, resulted in very similar mean and median values for [TSe] and molar TSe:THg compared to the original dataset, although the range of values was reduced (Corrigendum Table 1, Corrigendum Fig. 1).

We originally reported pups in the Western and Eastern Aleutian Islands had significantly lower median whole blood [TSe] than pups in the Central Aleutian Islands and the Central Gulf of Alaska (KW H = 16.542, p = 0.001, Z > 1.96) and pups from the Western and Central Aleutian Islands had significantly higher median whole blood [THg] compared to pups in rookeries to the east (Eastern Aleutian Islands and Central Gulf of Alaska; KW H = 88.478, p < 0.0001, Z > 1.96). Using only unadjusted [TSe] data, the regional relationship appears slightly more nuanced, with significantly lower median [TSe] in the Western Aleutian Islands compared with Central Aleutian Islands and Central Gulf of Alaska as originally reported, while pups from the Eastern Aleutian Islands had intermediate median [TSe] (KW H = 13.98, p = 0.008, Z > 1.96). The interacting factors resulted, as originally reported, in significantly lower whole blood molar TSe:THg in pups from Agattu Island (Western Aleutian Islands) compared to Ulak Island (Central Aleutian Islands) and rookeries at Bogoslof Island (Eastern Aleutian Islands) and Marmot Island (Central Gulf of Alaska) (KW H = 41.28, p < 0.0001, Z > 1.96).

⁎ Corresponding author at: Institute of Northern Engineering, Water and Environmental Research Center, University of Alaska Fairbanks, Fairbanks, AK 99775, USA.

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Reanalysis of whole blood [TSe] and molar THg:TSe, using only data for which no correction factor was applied to [TSe], reaffirms the original conclusion that young pups sampled on Agattu Island had significantly lower whole blood molar TSe:THg compared to Ulak Island and rookeries to the east (Bogoslof and Marmot Islands). With molar ratios as low as 1.9 and 2.5 at Agattu Island, pups with high whole blood [THg] may be at risk of insufficient circulating Se to protect from Hg toxicity and Hg induced Se deficiency. Pups at Seguam Island (Central Aleutian Islands) may be at similar risk although we have no unadjusted [TSe] data to confirm reduced whole blood molar ratios.

Corrigendum Table 1 (adapted from Table S3). Summary of total selenium analyses in whole blood of Steller sea lion pups (up to 5 weeks of age) indicating year and metapopulation of capture, sample sizes and sex of pups. Metapopulations sampled were Western Aleutian Islands (WAI), Central Aleutian Islands (CAI), Eastern Aleutian Islands (EAI), and Central Gulf of Alaska (CGOA). Data from 2013 to 15 for which no correction factor (CF) was applied are reported separately for comparison. Similar letters (a, b, c) indicate no significant difference between regions.

Corrigendum Fig. 1: Median total selenium to total mercury molar ratios (TSe:THg, no units) for Steller sea lion pups (Eumetopias jubatus) sampled at 7 islands in Alaska. Sample sizes presented in parentheses and similar letters (a, b, c) indicate no significant difference between islands. The black horizontal line denotes the 1:1 M ratio. Panel A includes all data from all rookeries and years as originally submitted, including those to which a correction factor was applied. Panel B includes only data where no correction factor was applied. Regions are indicated by color from west to east; red = Western Aleutian Islands, orange = Central Aleutian Islands, yellow = Eastern Aleutian Islands, green = Central Gulf of Alaska.

CRediT authorship contribution statement

Lorie Rea: Investigation, writing-original manuscript, visualization, project administration, funding acquisition.
J. Margaret Castellini: Investigation, validation, writing-original manuscript laboratory methods, writing-review and editing.
Julie Avery: Writing-review and editing.
Brian Fadely: Resources, visualization, writing-review and editing.
Vladimir Burkanov: Resources, writing-review and editing.
Michael Rehberg: Resources, project administration, funding acquisition, writing-review and editing.
Todd O’Hara: Writing-review and editing, supervision, funding acquisition.
Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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