Avian mercury exposure and toxicological risk across western North America: A synthesis

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ABSTRACT

Methylmercury contamination of the environment is an important issue globally and birds are useful bioindicators for mercury monitoring programs. The available data on mercury contamination of birds in western North America were synthesized. Original data from multiple databases were obtained and a literature review was conducted to obtain additional mercury concentrations. In total, 29219 original bird mercury concentrations from 225 species were compiled, and an additional 1712 mean mercury concentrations, representing 19998 individuals and 176 species, from 200 publications were obtained. To make mercury data comparable across bird tissues, published equations of tissue mercury correlations were used to convert all mercury concentrations into blood-equivalent mercury concentrations. Blood-equivalent mercury concentrations differed among species, foraging guilds, habitat types, locations, and ecoregions. Piscivores and carnivores exhibited the greatest mercury concentrations, whereas herbivores and granivores exhibited the lowest mercury concentrations. Bird mercury concentrations were greatest in ocean and salt marsh habitats and lowest in terrestrial habitats. Bird mercury concentrations were above toxicity benchmarks in many areas throughout western North America, and multiple hotspots were identified. Additionally, published toxicity benchmarks established in multiple tissues were summarized and translated into a common blood-equivalent mercury concentration. Overall, 66% of birds sampled in western North American exceeded a blood-equivalent mercury concentration of 0.2 μg/g wet weight (ww; above background levels), which is the lowest-observed effect level, 28% exceeded 1.0 μg/g ww (moderate risk), 8% exceeded 3.0 μg/g ww (high risk), and 4% exceeded 4.0 μg/g ww (severe risk). Mercury monitoring programs should sample bird tissues, such as adult blood and eggs, that are most-easily translated into tissues with well-developed toxicity benchmarks and that are directly relevant to bird reproduction. Results indicate that mercury contamination of birds is prevalent in many areas throughout western North America, and large-scale ecological attributes are important factors influencing bird mercury concentrations.

Key Words

Birds, Mercury, Eggs, Bioaccumulation, Toxicity Benchmarks

1. Introduction

Methylmercury contamination of the environment is an important issue globally because of continued anthropogenic emissions of mercury over time (Driscoll et al., 2013; Eagles-Smith et al., submitted to this issue; Weiss-Penzias et al., submitted to this issue), its ability to biomagnify through (primarily) aquatic food chains (Wiener et al., 2003), and its documented negative effects on fish and wildlife (Scheuhammer et al., 2007; Wiener et al., 2003). Birds are ubiquitous, top predators in many aquatic and terrestrial habitats, and often are subjected to elevated methylmercury concentrations (Cristol et al., 2008; Eagles-Smith et al., 2009a). Bird reproduction is particularly sensitive to mercury toxicity, with numerous documented deleterious effects to bird health, condition, behavior, and productivity (**Table 1**; Scheuhammer et al., 2007; Wiener et al., 2003). Together, these characteristics make birds useful bioindicators for local mercury contamination and regional monitoring programs (Day et al., 2012; Evers et al., 2011; Monteiro and Furness, 1995; Provencher et al., 2014; Weseloh et al., 2011).

Large-scale assessments of environmental pollution can be helpful for understanding the major drivers and distributions of contaminants in animals. A few studies have synthesized the available data on bird mercury contamination within the Great Lakes and northeastern regions of the United States and Canada (Evers et al., 2011; Jackson et al., 2015) and the Canadian Arctic (Mallory and Braune, 2012), but no such studies exist elsewhere in North America. Western North America is characterized by a diverse gradient of habitats, including both extremely dry and wet regions (National Assessment Synthesis Team, 2001). In particular, ephemeral wetland habitats are common across western North America (Tiner, 1984). The temporary wetting and drying of wetland habitats is often associated with biogeochemical conditions that tend to promote the methylation of inorganic mercury to its more toxic form, methylmercury (Ullrich et al., 2001). These ephemeral wetlands also tend to be highly productive and are greatly utilized by birds as foraging habitat (Murkin et al., 1997; Niemuth et al., 2006; Skagen et al., 2008). In addition to habitat-specific effects, mercury contamination in birds typically differs among foraging guilds, trophic levels, and species (Anderson et al., 2009; Blévin et al., 2013; Eagles-Smith et al., 2009a). Examining these effects over a large geographic area may identify hotspots of methylmercury contamination within bird populations, aid in prioritizing contaminant monitoring programs (Mason et al., 2005), and focus policy-making decisions.

In this synthesis paper, the available data on mercury contamination of birds in western North America are summarized. To do so, original, raw data from multiple databases were obtained and the literature was reviewed (published articles and reports) to extract mean mercury concentrations in birds for each species and site that has been studied. In total, nearly 30000 original, individual bird mercury concentrations from 225 species were compiled, and an additional >1700 mean mercury concentrations, representing nearly 20000 individuals and 176 species, from 200 publications were obtained. The goals were to describe the distribution of bird mercury contamination in western North America, identify potential hotspots, and examine the major factors influencing bird mercury concentrations. Specifically, the influence of species, foraging guild, habitat, ecoregion, and location on mercury contamination were examined for western North American birds. Additionally, the literature was reviewed, published toxicity benchmarks were summarized, and toxicity benchmarks established in multiple bird tissues were translated into a common blood-equivalent mercury concentration to integrate toxicity risk across avian life-stages and tissues. These toxicity benchmarks were then used to assess the toxicological risk of mercury exposure to birds in western North America.

2. Material and methods

2.1. Data acquisition: original data

Original data on mercury concentrations in individual birds from several sources were obtained. The U.S. Fish and Wildlife Service's Environmental Contaminants Data Management System (ECDMS) database (retrieved August 27, 2013), which contributed 25% of the data points, is an online database that houses contaminant data collected by government agencies. Additional original data were obtained from the authors' unpublished datasets at the U.S. Geological Survey (61% of the data); Biodiversity Research Institute (12%); the multi-partner Seabird Tissue and Archival Monitoring Project (STAMP; 2%); and Environment Canada (<1%). The databases were then merged, data was reviewed for quality, and the following information was extracted: bird species, tissue type (egg, whole blood, muscle, liver, kidney, and feathers), location (latitude and longitude), year, total mercury or methylmercury concentration, and units of measurement (including if data were reported in wet weight or dry weight). When location data were not reported within the study, study site descriptions (e.g., county or lake names) were used to assign approximate latitudes and longitudes using Google Earth™. Any incomplete data, including studies whose locations could not be determined, were excluded.

2.2. Data acquisition: literature review

A thorough literature review of all peer-reviewed journal articles and published reports documenting mercury concentrations in birds in western North America was conducted. Literature searches were conducted in Web of Science™ and Google Scholar™. For each study, the following information was extracted: bird species, tissue type, location (latitude and longitude), year, mean mercury concentration, units of measurement (including if data were reported in wet weight or dry weight), and sample size. Sometimes, year was reported as a range and, in these cases, the midpoint was used. When year was not reported, the publication year minus one was applied. Similarly, when sample sizes were reported as ranges, the midpoint was used as the sample size. When composite samples were used in a study, the number of composite samples was multiplied by the number of individual samples within the composites to calculate the effective sample size that was used in the study to produce the grand mean. When mean mercury concentrations were obtainable only from figures, rather than as values in a table or the text, the mean mercury concentration was visually approximated within the figure. Within the same study, mean mercury concentrations were kept separate for each species and location when possible; this often resulted with a single publication contributing multiple mean mercury concentrations, one mean for each species and location within the study. When location data were not reported within the study, study site descriptions (e.g., county and lake names) were used to assign approximate latitudes and longitudes using Google Earth™.

2.3. Assigning bird taxonomy, foraging guilds, and habitats

For both the original and literature-review data, each species was assigned to a foraging guild and general habitat type. Taxonomy was based on the seventh edition of the American Ornithologists' Union's Checklist of North and Middle American Birds (retrieved August 13, 2013 from http://checklist.aou.org/). Bird species were assigned to foraging guilds following DeGraaf et al. (1985) with the following modifications: (1) when a bird species occurred in multiple foraging guilds, such as piscivore and crustaceovore for several coastal seabirds, the primary foraging guild was used, and (2) when foraging guild differed by season (breeding, non-breeding, or year round), the foraging guild for the breeding season was used because most of the mercury data were from eggs or adults during the breeding season. Foraging guilds were categorized as piscivore, carnivore, insectivore, crustaceovore, molluscovore, vermivore, omnivore, granivore, or herbivore. Bird species were assigned to the following general habitats: ocean, coastal, salt marsh, both fresh and brackish water, freshwater, terrestrial-canopy, terrestrial-lower canopy, and terrestrial-ground. Habitats were assigned using DeGraaf et al.'s (1985) classifications as well as the Birds of North America series' (http://bna.birds.cornell.edu/bna/) habitat descriptions. All avian taxa (including order, family, and species), foraging guilds, and habitats are summarized in **Table S1**.

2.4. GIS data layers

Geographic Information Systems (GIS; ArcGIS 10.2, Environmental Research Systems Institute, Redlands, CA, USA) were used to attribute each sample location with landscape variables, including ecoregion and 100-km × 100-km grid cell. The U.S. Environmental

Protection Agency's ecoregion level one category (Commission for Environmental Cooperation, 1997), which separates North America into 15 distinct ecoregions, was used and two additional categories were added: one for samples collected in the Pacific and Arctic Oceans (including various small islands and atolls), and one for samples collected on the Hawaiian Islands, for a total of 17 possible ecoregions. The Create Fishnet geoprocessing tool (ArcGIS 10.2) was used to create a grid of cells, each measuring 100 km × 100 km, across the extent of the sample locations in western North America, and then the Spatial Join geoprocessing tool (ArcGIS 10.2) was used to attribute each data point with the ecoregion and grid cell it occupied. Distribution maps of mercury concentrations in birds throughout western North America were produced using ArcGIS 10.2, and overlaid on a physical base layer provided by the U.S. National Park Service.

2.5. Data transformations and assumptions

Numerous data assumptions and transformations were necessary to consolidate, organize, and convert various tissue types and concentration units into similar values. First, only the following tissues were included: whole blood, eggs, muscle, liver, kidney, and fully grown feathers. These tissues represented >98% of the available data, and they are more readily comparable to one-another than the other available tissues, such as whole carcass. Second, data from any laboratory dosing or artificial studies that did not represent data from wild birds were excluded. Data from hazard assessments were included, because the impetus for a large number of studies was a known or suspected hazard (especially within the ECDMS dataset). Third, data were included only for eggs, adult tissues, or post-fledged juveniles. Samples collected from pre-fledged juveniles were excluded, because chicks undergo rapid changes in mercury concentrations in internal tissues as they grow and age (Ackerman et al., 2011) making any comparisons difficult. Fourth, data for both total mercury and methylmercury were included. All mercury in eggs (Ackerman et al., 2013), whole blood (Rimmer et al., 2005), muscle (Scheuhammer et al., 1998), and feathers (Thompson and Furness, 1989) was assumed to be in the methylmercury form, and, therefore, total mercury and methylmercury concentrations were used to represent methylmercury concentrations in birds. A significant proportion of the mercury in liver and kidney can be in the inorganic form (Eagles-Smith et al., 2009b; Scheuhammer et al., 1998; Thompson and Furness, 1989). Very few data (<1%) were available for these tissues as methylmercury concentrations, but, for those limited data, methylmercury concentrations were transformed into equivalent total mercury (THg) concentrations by using an adjustment of 88% of THg being in the methylmercury form in liver (Eagles-Smith et al., 2009b). This assumption was justified because most data occurred below the 8.5 µg/g dry weight (dw) liver threshold where demethylation begins, above which a smaller proportion of THg as methylmercury would be expected in the liver (Eagles-Smith et al., 2009b). No adjustments were necessary for methylmercury concentrations in kidney, because THg concentrations were always available when methylmercury concentrations in kidneys were reported. Fifth, to make the mercury data comparable across bird tissues, all tissue concentrations were converted into blood-equivalent THg concentrations (µg/g) in wet weight (ww) using multiple equations from Eagles-Smith et al. (2008) and Ackerman et al. (2016a) detailed below. Before using these equations, it was necessary to convert THg concentration data from each tissue compartment into the same units, and thus all muscle, liver, kidney, and feather data were converted into dry weight THg concentrations (µg/g dw) using the reported percent moisture in the sample. Likewise, blood data were converted into wet weight THg concentrations (µg/g ww) using the reported percent moisture in the sample in the few instances (<1%) where blood was reported in dry weight. When moisture content was not reported, an average moisture content of 79% in blood, 67% in liver, 70% in muscle, and 74% in kidney was used (Eagles-Smith et al., 2008). For eggs, it is important to report mercury concentrations on a fresh wet weight (fww) basis (Ackerman et al., 2013; Stickel et al., 1973); however, the necessary egg morphometrics to make these adjustments were not available in many of the raw datasets and this made the conversion to fresh wet weight not possible. Therefore, when egg morphometric data were unavailable, egg THg concentrations (µg/g) were converted on a dry weight basis into a wet weight basis using the reported percent moisture in the individual egg or, when moisture content was not reported, an average egg moisture content of 75% was used (Ackerman et al., 2013). When egg morphometric data were available (i.e., authors' data), THg concentrations on a fresh wet weight basis (µg/g fww) were used and calculated following Ackerman et al. (2013). In one instance, only albumen THg concentrations (µg/g ww) were reported, and the albumen THg concentration was converted into a whole-egg THg concentration (µg/g fww) using the predictive equation in Stebbins et al. (2009), before conversion into a blood-equivalent THg concentration. Hereafter, all egg THg concentrations are reported as simply µg/g ww. For most analyses, data points that were derived from the same bird, but in a different tissue, were excluded. Priority was given to tissues from the same bird in the following order: whole blood, eggs, muscle, liver, kidney, and fully grown feathers (see **Table 2**).

To convert THg concentrations in bird tissues into THg concentrations in blood, the following equations (eqs. 1-4) from Eagles-Smith et al. (2008), which were developed from >600 birds of 4 bird species with a broad range of tissue THg concentrations, were used. For the feather equation, the predictive equation for breast feathers, rather than head feathers, was used because most of the feathers sampled are typically body feathers and this differentiation among feather types was not usually reported.

$$(eq. 1;\ R^2 = 0.90):\ \ln\left(Blood\ THg\ \tfrac{\mu g}{g}_{ww}\right) = 1.080 \times \ln\left(Bird\ Muscle\ THg\ \tfrac{\mu g}{g}_{dw}\right) - 1.024$$

$$(eq. 2;\ R^2 = 0.88):\ \ln\left(Blood\ THg\ \tfrac{\mu g}{g}_{ww}\right) = 0.970 \times \ln\left(Bird\ Liver\ THg\ \tfrac{\mu g}{g}_{dw}\right) - 1.929$$

$$(eq. 3;\ R^2 = 0.87):\ \ln\left(Blood\ THg\ \tfrac{\mu g}{g}_{ww}\right) = 1.003 \times \ln\left(Bird\ Kidney\ THg\ \tfrac{\mu g}{g}_{dw}\right) - 2.008$$

$$(eq. 4;\ R^2 = 0.32):\ \ln\left(Blood\ THg\ \tfrac{\mu g}{g}_{ww}\right) = 0.673 \times \ln\left(Bird\ Feather\ THg\ \tfrac{\mu g}{g}_{dw}\right) - 1.673$$

To convert THg concentrations in eggs into equivalent THg concentrations in blood, the following equation (eq. 5) from Ackerman et al. (2016a), that was developed using 83 females and their full clutches for 3 species with a broad range of tissue THg concentrations, was used:

$$(eq. 5;\ R^2 = 0.95): \ln\left(Female\ Bird\ Blood\ THg\ \tfrac{\mu g}{g}_{ww}\right) = 1.0734 \times \ln\left(Egg\ THg\ \tfrac{\mu g}{g}_{fww}\right) + 0.8149$$

These tissue conversion equations (1-5) were developed for multiple species and used the largest sample sizes currently available, and therefore represent the best available conversion equations for multiple species. However, these equations were developed for four species in the order Charadriiformes and may not be representative of all bird species.

2.6. Statistical analysis

Linear mixed-effects models were used to examine factors influencing blood-equivalent THg concentrations in birds. Separate analyses were conducted for the two types of datasets: original raw data and the literature-review data. This separation ensured that data were not pseudoreplicated within the analyses because some of the original raw datasets were used to publish journal articles and reports that were summarized in the literature review dataset. THg concentrations in birds were $\log_e$-transformed (natural log denoted as ln in equations) to improve normality. Back-transformed least squares means are reported with standard errors that were estimated using the delta method (Seber, 1982).

For the original raw dataset, $\log_e$-transformed blood-equivalent THg concentration was the dependent variable; foraging guild (9 guilds), habitat (8 habitats), and ecoregion (11 ecoregions) were fixed factors; and grid cell (432 grid cells each 100 km × 100 km), year (29 years: 1982-2015), and species (225 species) were random factors. To compare THg concentrations among species without the inclusion of habitat and foraging guild, a separate analysis was conducted where $\log_e$-transformed blood-equivalent THg concentration was the dependent variable; species was a fixed factor; and grid and year were random factors. To examine the spatial distribution of THg in birds without the inclusion of habitat and foraging guild, an additional analysis was conducted where $\log_e$-transformed blood-equivalent THg concentration was the dependent variable; grid was a fixed factor; and species and year were random factors. This same analysis was repeated for each guild with sample sizes >5000 (within a guild) to specifically examine the distribution of THg in birds in the piscivore (n=10243), insectivore (n=8464), and omnivore (n=6685) guilds.

For the literature-review dataset, $\log_e$-transformed mean blood-equivalent THg concentration was the dependent variable; foraging guild (8 guilds), habitat (8 habitats), and ecoregion (15 ecoregions) were fixed factors; and grid cell (313 grid cells), year (46 years: 1968-2013), and species (176 species) were random factors. For this analysis, blood-equivalent mean THg concentrations were weighted by the square-root of the study's effective sample size (i.e., the number of individuals used to estimate the mean), which placed more emphasis on the mean estimates that were derived from larger sample sizes. To compare mean THg concentrations among species without the inclusion of habitat and foraging guild, an analysis was conducted where $\log_e$-transformed mean blood-equivalent THg concentration was the dependent variable; species was a fixed factor; and grid and year were random factors. To examine the distribution of mean THg concentrations in birds without the inclusion of habitat and foraging guild, an additional analysis was conducted where $\log_e$-transformed mean blood-equivalent THg concentration was the dependent variable; grid was a fixed factor; and species and year were random factors.

2.7. Literature review of mercury toxicity to birds and translation of toxicity benchmarks into a common blood-equivalent tissue

A thorough literature review was conducted and published toxicity benchmarks for all bird tissues were summarized (**Table 1**). These toxicity benchmarks were then integrated across avian tissues and life-stages into a single toxicity benchmark based on blood-equivalent THg concentrations. To do so, equations and assumptions noted in Table 1's footnotes were used to convert each of the toxicity benchmarks in various tissues into blood-equivalent THg concentrations. These equations and assumptions are described in more detail in section 2.5.

3. Results & Discussion

Original, raw data on THg concentrations in 29219 samples were obtained for 225 bird species. Most of the available data were for eggs (69%), followed by blood (16%), liver (7%), feathers (3%), kidney (3%), and muscle (2%). For most analyses, 1590 data points that were derived from the same bird, but in a different tissue, were excluded yielding a final sample size of 27629 birds. THg concentrations are summarized by species and tissues in **Tables S2-S8**. From the literature, 1712 mean THg concentrations were obtained for 176 bird species, representing 19998 individuals, from 200 publications (**Supplementary Material: References**). **Figure 1a** displays the distribution of THg concentrations using the original, raw data and **Figure 1b** displays the distribution of mean THg concentrations using data from the literature review.

3.1. Factors influencing bird mercury: original raw data

Bird blood-equivalent THg concentrations differed among foraging guilds ($F_{8,192.3}$=11.72, p<0.0001; **Figure 2a**) and habitat types ($F_{7,349.1}$=12.69, p<0.0001; **Figure 2b**), but did not differ among ecoregions ($F_{10,949.1}$=0.93, p=0.50). Piscivores (0.33±0.05 µg/g ww) and carnivores (0.32±0.10 µg/g ww) exhibited the greatest blood-equivalent least squares mean THg concentrations, whereas herbivores (0.03±0.01 µg/g ww) and granivores (0.02±0.01 µg/g ww) exhibited the lowest blood-equivalent least squares mean THg concentrations. These results are consistent with other studies that have found that birds foraging at higher trophic levels often have higher THg concentrations due to the biomagnification of methylmercury through food chains (Anderson et al., 2009; Blévin et al., 2013). In contrast, birds foraging on plants and seeds at the base of the food chain had substantially lower THg concentrations. Although these results were expected based on the ability of methylmercury to biomagnify, this is the first study to demonstrate differences in THg concentrations among such a wide range of foraging guilds.

Bird blood-equivalent least squares mean THg concentrations were greatest in ocean (0.49±0.22 µg/g ww) and salt marsh (0.31±0.07 µg/g ww) habitats and lowest in terrestrial-ground habitats (0.04±0.01 µg/g ww; **Figure 2b**). Aquatic environments have biogeochemical conditions that are more conducive to methylation and methylmercury is more prevalent in aquatic than terrestrial ecosystems (Ullrich et al., 2001); therefore, it was not surprising that THg concentrations in birds would be lower in terrestrial than aquatic environments. However, some terrestrial birds can receive substantial aquatic subsidies of methylmercury through emergent aquatic insects and the associated food web (Cristol et al., 2008; Jackson et al., 2011b), so some terrestrial species can be exposed to higher methylmercury levels than would be assumed based upon their terrestrial foraging habits. Ocean and estuary environments tended to have birds with higher THg concentrations than those in freshwater environments. This difference could be due to several mechanisms, including differences in bioavailable methylmercury (such as differences in biogeochemical conditions, inorganic mercury availability, and methylmercury production; Ullrich et al., 2001), generally more complex food web structures and longer food-chain lengths in oceans and estuaries compared to smaller freshwater ecosystems (Post, 2002), or the ecology of bird species in these different habitats.

Blood-equivalent THg concentrations also differed among bird species ($F_{224,22076}$=130.79, p<0.0001; **Figure 3**; **Figures S1-S7**; **Table S8**). In particular, Forster's terns had the highest least squares mean blood-equivalent THg concentrations of any species with sample sizes ≥60 (**Figure 3**), which is the approximate sample size necessary to estimate a population's mean THg concentration with 10% accuracy (Ackerman et al., 2016b). Blood-equivalent geometric mean THg concentrations were 2.35 µg/g ww in Forster's terns (5^{th} to 95^{th} percentile: 0.87-6.39 µg/g ww; **Table S8**). For comparison, common loons in the west, another piscivore that is well studied throughout North America, had a blood-equivalent geometric mean THg concentration of 0.89 µg/g ww (5^{th} to 95^{th} percentile: 0.25-3.90 µg/g ww; **Table S8**). Some other species with notably high blood-equivalent geometric mean THg concentrations were pigeon guillemots (2.08 µg/g ww), Caspian terns (1.58 µg/g ww), least terns (1.15 µg/g ww), black skimmers (0.90 µg/g ww), Clark's grebes (0.83 µg/g ww), and black-necked stilts (0.79 µg/g ww; **Table S8**).

Blood-equivalent THg concentrations of individual birds were above common toxicity benchmarks (**Table 1**) in many areas throughout western North America (**Figure 1a**). In particular, multiple individuals exhibited THg concentrations above 3.0 µg/g ww in San Francisco Bay, California; Central Valley, California; Carson River watershed, Nevada; Great Salt Lake, Utah; northeastern Washington; northeastern Montana; multiple sites along the Missouri River; southern Arizona; the Gulf Coast of Texas; Alaska's North Slope; and the Aleutian Archipelago. These individuals typically were from species belonging to upper trophic level guilds, such as piscivores and carnivores.

To examine spatial variation in mercury exposure of birds that accounted for differences in THg concentrations among species, the distribution of blood-equivalent THg concentrations in birds also were mapped using model-estimated least squares means within 100-km × 100-km grid cells across western North America. As expected, bird blood-equivalent THg concentrations differed among grid cells ($F_{431,26126}$=20.67, p<0.0001; **Figure 4a**). Model-estimated mean THg concentrations were greatest in coastal California, western Nevada, and Alaska's North Slope (**Figure 4a**). Other apparent hotspots, such as those in other parts of Alaska, British Columbia, Hawaiian Islands, and the western contiguous United States, had high THg concentrations but low sample sizes (typically <15; **Figure 4b**) and high coefficients of variation (>25%; **Figure 4c**) making interpretation at these sites more difficult. The analysis was repeated separately for each guild with a sample size >5000 and similar results were generally found for the piscivore (**Figure 5a**), insectivore (**Figure 5b**), and omnivore guilds (**Figure 5c**). THg concentrations were compared among guilds when they overlapped in the same grid cell. The strength of the correlations between guild-specific least squares mean blood-equivalent THg concentrations within grid cells varied among guilds, although the relationships were always positive (Pearson correlations; omnivore vs insectivore: n=79 grid cells, r=0.47, p<0.0001; omnivore vs piscivore: n=56 grid cells, r=0.24, p=0.08; piscivore vs insectivore: n=69 grid cells, r=0.16, p=0.19).

3.2. Factors influencing bird mercury: literature review

Bird blood-equivalent least squares mean THg concentrations differed among foraging guilds ($F_{7,167.1}$=16.01, p<0.0001; **Figure 2a**), habitat types ($F_{7,211}$=2.86, p=0.01; **Figure 2b**), and ecoregions ($F_{14,283.3}$=2.08, p=0.01; **Figure 6**). Carnivores (0.37±0.15 µg/g ww) and piscivores (0.31±0.09 µg/g ww) exhibited the greatest blood-equivalent least squares mean THg concentrations, whereas herbivores (0.01±0.01 µg/g ww) exhibited the lowest blood-equivalent least squares mean THg concentrations. As observed in the raw dataset, bird blood-equivalent least squares mean THg concentrations were highest in salt marsh (0.35±0.28 μg/g ww) and ocean (0.23±0.08 μg/g ww) habitats and lowest in terrestrial-ground habitats (0.04±0.01 μg/g ww). Among ecoregions, bird blood-equivalent least squares mean THg concentrations were greatest in tropical dry forests (0.22±0.13 μg/g ww) and tundra habitats (0.22±0.06 μg/g ww) and lowest in temperate Sierras (0.06±0.03 μg/g ww) and southern semi-arid highlands (0.04±0.02 μg/g ww), but pair-wise comparisons suggested few statistically significant differences among ecoregions (**Figure 6**).

Similar to the raw dataset, bird blood-equivalent mean THg concentrations differed among species ($F_{177,1427}$=10.61, p<0.0001; **Figures S8-S14**) and grid cells ($F_{312,1195}$=4.17, p<0.0001; **Figure 7a**). Model-estimated mean bird THg concentrations based on the literature data also were highest in central and coastal California, western Nevada, Alaska's North Slope, and the Aleutian Islands (**Figure 7a**). Additional hotspots were present throughout the west, although several of these additional sites had low sample sizes (typically <15; **Figure 7b**) and high coefficients of variation (>25%; **Figure 7c**). To directly compare the raw data (432 grid cells) to the literature data (313 grid cells), model-estimated mean bird THg concentrations within the 165 grid cells (100 km^2) that contained both raw data and literature-review data were correlated. Least squares mean blood-equivalent THg concentrations were positively correlated between the two separate datasets, although the strength of the correlation was moderate (Pearson correlation; r=0.34; p<0.0001).

3.3. Hotspots of bird mercury contamination in western North America

From the raw and literature-review data analyses, hotspots were identified in western North America for mercury contamination in birds. Several of these identified hotspots were common to both the raw and literature-review datasets, including the western Aleutian Islands, Alaska's North Slope, Great Basin (especially western Nevada), and San Francisco Bay and Central Valley of California (**Figures 4 and 7**). To facilitate visualization of avian mercury exposure risk across western North America, a comprehensive map (**Figure 8**) was produced by combining the maps developed from the raw data and the literature-review data. When a grid cell contained THg concentration estimates from both analyses, priority was given to the estimate derived from the raw data and excluded the literature review-derived estimate for that grid cell. All grid cells that contained least squares mean blood-equivalent THg concentrations that were above the 80^{th} percentile of the entire dataset were considered to be potential hotspots for bird mercury contamination. Using this approach, 101 grid cells were identified that can be considered to be hotspots for avian mercury contamination in western North America (red grid cells in **Figure 8**). These hotspots included locations in the Aleutian Islands; the North Slope of Alaska; east-central Alaska; southeastern Alaska; northern Nunavut, Canada; Puget Sound, Washington; Great Basin (especially northern Idaho, and western and northern Nevada); San Francisco Bay and Central Valley, California; southern Arizona; the Gulf Coast of Texas; and the Hawaiian Islands (**Figure 8**).

Among the grid cell hotspots identified from the combination of the raw and literature-review datasets, many were characterized by low sample sizes (<15 samples; n=1 grid cell), high coefficients of variation (>25%; n=7 grid cells), or both (n=71 grid cells). Thus, additional sampling in these locations would help to determine if they are hotspots for bird mercury contamination. On the other hand, 22 of the identified hotspots were well sampled (>15 samples) and had relatively low coefficients of variation (<25%). These identified hotspots (red grid cells with bolded black borders in **Figure 8**) included the North Slope of Alaska; the western Aleutian Islands; Puget Sound; southwestern Idaho; western Wyoming; northern Montana; North Dakota and South Dakota along the Missouri River; central Arizona; the Gulf Coast of Texas; western Nevada; and San Francisco Bay, California. Similar hotspots of mercury contamination were observed at some sites for freshwater fishes, especially in western and northern Nevada and central Arizona (Eagles-Smith et al., submitted to this issue). Avian mercury hotspots on the North Slope of Alaska may reflect recent trends in increased mercury exposure observed in piscivorous birds in the Arctic (Evers et al., 2014; Rigét et al., 2011), which are thought to be related to atmospheric deposition (Blum et al., 2013; Sunderland et al., 2009) and warmer Arctic temperatures associated with climate change potentially releasing inorganic mercury within snowpack, permafrost, and sea ice, and enhancing methylmercury production (AMAP, 2002; Brooks et al., 2006). In the Aleutian Islands, several studies have demonstrated high THg concentrations in birds with concentrations sometimes increasing westward across the island chain (Anthony et al., 2007; Ricca et al., 2008). In Washington's Puget Sound, surf scoters exhibited THg concentrations similar to those of surf scoters in San Francisco Bay, California (Henny et al., 1991; Ohlendorf et al., 1987) and mercury concentrations of both surf scoters and western grebes increased as they over-wintered in Puget Sound (Henny et al., 1991, 1990). The hotspot in the Gulf Coast of Texas included Lavaca Bay, a designated mercury superfund site. Finally, San Francisco Bay estuary, California and western Nevada, have a long history of mercury contamination due to the legacy of mining (Conaway et al., 2008; Singer et al., 2013) and have widespread mercury contamination of biota (Ackerman et al., 2008, 2007; Eagles-Smith and Ackerman, 2014; Eagles-Smith et al., 2009a; Henny et al., 2007, 2002). San Francisco Bay, California; western Nevada; and other Great Basin areas are of particular concern for methylmercury exposure to birds in western North America, and would benefit from inclusion in continental contaminant monitoring programs (Mason et al., 2005).

3.4. Literature review of mercury toxicity to birds and translation of toxicity benchmarks into a common blood-equivalent tissue

The literature was reviewed, the published toxicity benchmarks for birds were summarized, and toxicity benchmarks for different tissues were integrated into a common blood-equivalent THg concentration (**Table 1**). This approach provides the ability to integrate toxicity risk across avian tissues and life-stages into a single toxicity benchmark based on bird blood. Effects occurred across a range of blood-equivalent THg concentrations, with many documented effects in the range of 1.0 to 3.0 µg/g ww and more severe effects occurring over 3.0 µg/g ww (**Table 1**). The lowest documented effects in birds occurred at a blood-equivalent THg concentration of 0.2 µg/g ww (**Table 1**). In general, health, physiology, behavior, and reproduction tended to be affected by methylmercury at lower blood-equivalent THg concentrations (1.0 µg/g ww), substantial impairment to health and reproduction occurred at moderate blood-equivalent THg concentrations (2.0 µg/g ww), more severe impairment to health and reproduction occurred at higher blood-equivalent THg concentrations (3.0 µg/g ww), and often complete reproductive failure occurred at extremely high blood-equivalent THg concentrations (4.0 µg/g ww; **Table 1**). THg concentrations in blood over 4.0 µg/g ww in bird blood resulted in a variety of severe physiological and reproductive effects, including adult mortality at blood-equivalent THg concentrations over 8.5 µg/g ww (**Table 1**).

At approximately 1.0 µg/g ww in bird blood, effects of methylmercury exposure included altered bird breeding behaviors (Frederick and Jayasena, 2010; Tartu et al., 2015); reduced breeding success of south polar skuas during the subsequent breeding season (Goutte et al., 2014); reduced egg hatchability (LC_{50}: lethal concentration where 50% mortality occurs) of highly-sensitive birds (Heinz et al., 2009b); an estimated 12% reduction in common loon productivity (Burgess and Meyer, 2008); reduced egg hatchability (LC_{50}) in thick-billed murres (Braune et al., 2012); the onset of demethylation of methymercury in the liver of Forster's terns, Caspian terns, American avocets, and black-necked stilts (Eagles-Smith et al., 2009b); changes to enzymes associated with glutathione metabolism and antioxidant activity in ruddy ducks (Hoffman et al., 1998); and impaired behavior of common loons (Depew et al., 2012). A bird blood-equivalent THg concentration of 1.0 µg/g ww also is very close to the derived toxicity benchmark for impaired bird reproduction using egg and liver tissue in the review by Shore et al. (2011). At approximately 2.0 µg/g ww in bird blood, effects of methylmercury exposure included impaired reproduction in captive dosed mallards (Heinz, 1979); reduced egg hatchability (LC_{50}) of moderately-sensitive birds (Heinz et al., 2009b); reduced breeding success of brown skuas during the subsequent breeding season (Goutte et al., 2014); an estimated 23% reduction in common loon productivity (Burgess and Meyer, 2008); reduced egg hatchability (LC_{50}) in Arctic terns (Braune et al., 2012); and impaired productivity of common loons (Depew et al., 2012). At approximately 3.0 µg/g ww in bird blood, effects of methylmercury exposure included impaired productivity (Barr, 1986), reproductive failure (Depew et al., 2012; Evers et al., 2008), and a 35% reduction in the productivity of common loons (Burgess and Meyer, 2008); decreased immune competence in tree swallows (Hawley et al., 2009); and decreased egg hatchability in ring-necked pheasants (Fimreite, 1971). Finally, at approximately 4.0 µg/g ww in bird blood, effects of methylmercury exposure became widespread among most bird species and included reduced egg hatchability (LC_{50}) of birds that are less-sensitive to methylmercury toxicity (Heinz et al., 2009b); reduced egg hatchability (LC_{50}) in common loons (Kenow et al., 2011); increased incidence of same-sex pairs (Frederick and Jayasena, 2010); and an estimated 50% reduction in common loon productivity (Burgess and Meyer, 2008).

Because sensitivity to methylmercury toxicity can differ widely among species (Heinz et al., 2009b), it is difficult to select a single toxicity benchmark that can be applied across species, such as for the 273 species included in this paper (**Table S1**). However, some general principles can be derived from the synthesis of published toxicity studies that can be used to guide the interpretation of bird methylmercury concentrations (**Table 1**). In general, birds with blood THg concentrations <0.2 µg/g ww are below any known effect levels and can be considered to have background levels of methylmercury exposure. Birds with blood THg concentrations between 0.2-1.0 µg/g ww can be considered to have lower risk, 1.0-3.0 µg/g ww have moderate risk, 3.0-4.0 µg/g ww have higher risk, and >4.0 µg/g ww have severe risk to methylmercury toxicity. Overall, 66% of individual birds exceeded a blood-equivalent THg concentration of 0.2 µg/g ww (above background levels), 28% exceeded 1.0 µg/g ww (moderate risk and above), 8% exceeded 3.0 µg/g ww (high risk and above), and 4% exceeded 4.0 µg/g ww (severe risk; **Table S9**). Because numerous effects to health and reproduction occur in many bird species at blood THg concentrations near 3.0 µg/g ww (**Table 1**), that is a useful methylmercury toxicity benchmark for the potential for more severe impairment to bird health and reproduction. Species with >5% of individuals exceeding THg concentrations of 3.0 µg/g ww in blood included horned grebe (100%), black-footed albatross (44%), Forster's tern (33%), pigeon guillemot (30%), willet

(25%), northern fulmar (23%), northern shoveler (19%), black skimmer (13%), Clark's grebe (11%), clapper rail (11%), American white pelican (11%), Caspian tern (10%), peregrine falcon (9%), least tern (9%), common loon (8%), double-crested cormorant (8%), black-necked stilt (8%), Wilson's phalarope (8%), snowy plover (7%), and ruddy turnstone (7%; **Table S9**). Songbirds, in particular, may be more sensitive to methylmercury toxicity (Heinz et al., 2009b), and substantial impairment may occur at blood THg concentrations of only 1.0 µg/g ww (**Table 1**). The percentage of individual songbirds exceeding 1.0 µg/g ww included western kingbird (40%), bank swallow (20%), American robin (10%), yellow-breasted chat (7%), ash-throated flycatcher (4%), willow flycatcher (4%), tree swallow (3%), house wren (2%), rusty blackbird (2%), white-crowned sparrow (2%), and barn swallow (1%; **Table S9**). **Table S9** can be used to examine additional species at a range of blood-equivalent THg concentrations from 0.2 to 4.0 µg/g ww. **Figure 9** shows the proportion of individual birds exceeding various toxicity benchmarks only for those species with ≥60 samples. Often, there can be as much variability in THg concentrations among individuals of the same species as among species due to the substantially large influences of local site and habitat-specific effects on methylmercury production and bioaccumulation (Eagles-Smith et al., 2009a); therefore comparisons among species (**Figures S2-S14**) should be viewed as approximations of relative methylmercury exposure at this large scale of study.

4. Suggestions for mercury monitoring programs

To compile mercury contamination data in birds throughout western North America, many different datasets derived from seven different tissues (egg, albumen, whole blood, muscle, liver, kidney, and feathers) were used. It was necessary to make several assumptions and to use general equations to translate these seven tissues into a common matrix − blood-equivalent THg concentrations − for comparisons among studies and species. These generalities introduced uncertainty into the resulting estimates of blood-equivalent THg concentrations, especially for tissues like adult feathers. These results suggest that future mercury monitoring efforts would benefit from sampling tissues that are most-easily translated into a tissue that has a well-developed toxicity benchmark and that is directly relevant to bird reproduction (**Table 2**). These high-priority sampling tissues include adult blood, eggs, and chick down feathers (in contrast to low-priority adult feathers). Bird THg concentrations in whole blood are highly correlated to THg and methylmercury concentrations in internal tissues that require more invasive sampling procedures (Eagles-Smith et al., 2008). Additionally, the THg concentration in a female's blood is highly correlated to THg concentrations in her eggs (Ackerman et al., 2016a), providing THg concentrations in blood with a strong link to the numerous toxicity benchmarks that have been developed for egg hatchability. Eggs are a high-priority sampling tissue because they are relatively easy to sample, and relate directly to many toxicity benchmarks, including impaired reproduction. Egg THg concentrations need to be reported on a fresh wet weight basis (Ackerman et al., 2013; Stickel et al., 1973), and therefore it is necessary to collect additional egg morphometric data (such as egg length, width, and weight) for proper adjustments to the measured egg THg concentrations. Down feathers also can be a useful tissue, because THg concentrations in down feathers represent *in ovo* exposure and can be translated into equivalent THg concentrations in whole eggs (Ackerman and Eagles-Smith, 2009). Besides chick down feathers, sampling juvenile birds for contaminant monitoring purposes is not advised, because THg concentrations in internal tissues (including blood) change rapidly as chicks age due to mass dilution and mercury transfer into growing feathers (Ackerman et al., 2011; Kenow et al., 2007) and, therefore, are difficult to interpret.

Tissues which have a moderate-priority for assessing bird contamination include egg albumen, that can be non-lethally sampled and translated into whole-egg THg concentrations (Ackerman and Eagles-Smith, 2009; Stebbins et al., 2009); and muscle, liver, kidney, and brain, which are highly correlated to other internal tissues, including whole blood (Eagles-Smith et al., 2008; Scheuhammer et al., 2008), but require more invasive sampling procedures. Additionally, unlike in blood, eggs, muscle, and feathers, most of the THg in the liver and kidney often is not in the methylmercury form due to the ability of birds to demethylate methylmercury within the liver, especially at high THg concentrations (Eagles-Smith et al., 2009b; Henny et al., 2002; Scheuhammer et al., 2008). Therefore, chemical determination of methylmercury, in addition to THg, may be necessary when using liver and kidney tissues. Finally, although many mercury monitoring programs use them, feathers have low-priority as a preferred tissue for sampling. Feather THg concentrations are highly variable within an individual bird (Bond and Diamond, 2008; Braune and Gaskin, 1987; Cristol et al., 2012; Furness et al., 1986), and are relatively poorly correlated with THg concentrations in internal tissues (Eagles-Smith et al., 2008; Evers et al., 1998) that are more likely to indicate risk of current methylmercury toxicity. Furthermore, THg concentrations in feathers represent THg concentrations in blood at the time of feather growth, which is a combination of the bird's body burden of mercury, via redistribution of mercury among internal tissues during molt, and recent mercury acquired through diet (Braune and Gaskin, 1987; Furness et al., 1986; Thompson et al., 1998). Not only is the timing of feather molt often unknown, but molt may represent a time when internal mercury concentrations are rapidly changing due to mercury transfer to feathers (Ackerman et al., 2011; Condon and Cristol, 2009) and the often-associated nutritional stress. There are certainly exceptions where adult feathers may be useful for mercury monitoring, including (1) for non-migratory bird species with extremely small home ranges (or other ecology) which make THg concentrations in feathers highly correlated to those in internal tissues (Ackerman et al., 2012), (2) when more invasive sampling methods need to be avoided (such as endangered species), or (3) when using museum specimens to examine long-term temporal trends, because no other tissue is available (Bond et al., 2015; Monteiro and Furness, 1997).

In addition to selecting the most useful bird tissues, reasonable efforts to ensure adequate sample sizes are acquired are important for properly characterizing methylmercury risk to birds. Few studies have been published on this topic, but Ackerman et al. (2016b) demonstrated that to estimate a population's mean THg concentration using eggs would typically require >60 samples to be within 10% of the population's actual mean THg concentration. Similar sample sizes would be necessary for other bird populations when variance in THg concentrations is comparable to any of the three species in that study. Sampling fewer individuals will result in an estimate that has lower accuracy, but sampling 15-30 individuals will normally provide an estimate within 20% of the population's actual mean THg concentration (Ackerman et al., 2016b).

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TABLES

Table 1. Summary of toxicity benchmarks for the effects of methylmercury exposure on birds. Toxicity benchmarks were translated from the original tissue from which they were derived into blood-equivalent units using correlational models of total mercury concentrations between blood and various tissues. The table is sorted from the lowest to the highest blood-equivalent total mercury concentration where a toxic effect of methylmercury on birds was observed. Effects on juvenile birds were excluded due to the temporal complexity of methylmercury concentrations in chicks as they age, and the inability to reliably translate chick total mercury concentrations into equivalent total mercury concentrations in adult blood. Acronyms are blood = whole blood; RBCs = red blood cells; ww = wet weight; dw = dry weight; fww = fresh wet weight; THg = total mercury concentration; MeHg = methylmercury concentration; LC_{50}: lethal concentration where 50% mortality occurs; na = no equation was needed to translate into blood total mercury concentration.

			Original tissue THg					
Impairment category	Hg toxicity effect	Blood-equivalent THg (µg/g ww)	Tissue	Benchmark	Units	Bird species	Study[a]	Blood-equivalent equation[b,c]
Health and physiology	Oxidative stress response: negative relationship with thiobarbituric acid activity (below this concentration)[d]	0.2	Liver	1.60	µg/g dw	Lesser Scaup	Custer et al. (2000)	1
Health and physiology	Altered gene expression in females (below this concentration)[d]	0.3	RBCs	1.20	µg/g dw	Double-crested Cormorant	Gibson et al. (2014)	2
Reproduction	Median for males that raised only 1 of 2 chicks; no males above this threshold successfully raised 2 chicks	0.3	RBCs	1.20	µg/g dw	Black-legged Kittiwake	Tartu et al. (2015b)	2
Reproduction	Decreased egg hatchability (mean of eggs from dosed females)	0.3	Egg	0.15	µg/g ww	Ring-necked Pheasant	Spann et al. (1972)[a]	3
Reproduction	Median for birds that skipped breeding (higher than birds that bred); altered hormones	0.4	RBCs	2.00	µg/g dw	Black-legged Kittiwake	Tartu et al. (2013)	2
Behavioral	Increased egg neglect for males (lower concentrations had no observed egg neglect)	0.4	RBCs	2.00	µg/g dw	Snow Petrel	Tartu et al. (2015a)	2

Reproduction	Egg hatchability: LC_{50} of egg-injected birds ranked as high sensitivity to MeHg	0.5	Egg	0.25	µg/g ww	Multiple	Heinz et al. (2009a)[a]	3
Reproduction	10% reduction in probability of nest success	0.7	Blood	0.70	µg/g ww	Carolina Wren	Jackson et al. (2011)	na
Reproduction	13% decrease in productive nests; altered courtship behaviors (mean of dosed birds)	0.7	Blood	0.73	µg/g ww	White Ibis	Frederick and Jayasena (2010)[a]	na
Reproduction	Probability of breeding successfully the subsequent year drops below 50%	0.8	RBCs	3.90	µg/g dw	South Polar Skua	Goutte et al. (2014)	2
Reproduction	Proposed indicative concentration for impaired reproduction (review)	0.8	Liver	2.00	µg/g ww	Multiple	Shore et al. (2011)	1
Reproduction	10% reduction in max. productivity	0.9	Blood	0.90	µg/g ww	Common Loon	Burgess and Meyer (2008)	na
Health and physiology	Negative relationship with cortisol (below this concentration)[d]	1.0	Blood	1.00	µg/g ww	Tree Swallow	Franceschini et al. (2009)	na
Reproduction	Decreased egg hatchability	1.1	Egg	0.50	µg/g ww	Ring-necked Pheasant	Fimreite (1971)	3
Health and physiology	MeHg demethylation threshold in liver	1.2	Liver	8.51	µg/g dw	Forster's Tern, Caspian Tern, American Avocet, Black-necked Stilt	Eagles-Smith et al. (2009b)	1
Reproduction	20% reduction in probability of nest success	1.2	Blood	1.20	µg/g ww	Carolina Wren	Jackson et al. (2011)	na
Reproduction	Egg hatchability: LC_{50} of egg-injected and maternally derived MeHg	1.2	Egg	0.56	µg/g ww	Thick-billed Murre	Braune et al. (2012)[a]	3
Health and physiology	Glutathione metabolism and antioxidant activity (effect on associated enzymes below this concentration)[d]	1.2	Liver	9.00	µg/g dw	Ruddy Duck	Hoffman et al. (1998)	1
Reproduction	Decrease in productivity	1.3	Egg	3.00	µg/g dw	Merlin	Newton and Haas (1988)	3

Reproduction	Proposed indicative concentration for impaired reproduction (review)	1.3	Egg	0.60	µg/g ww	Multiple	Shore et al. (2011)	3
Behavioral	Impaired behavior (review)	1.4	Diet (fish)	0.10	µg/g ww	Common Loon	Depew et al. (2012)	4
Health and physiology	Negative relationship with body condition (below this concentration)[d]	1.6	Blood	1.56	µg/g ww	Clapper Rail	Ackerman et al. (2012)	na
Reproduction	Decreased egg hatchability (mean of contaminated site)	1.6	Egg	2.86	µg/g dw	House Wren	Custer et al. (2007)	3
Reproduction	15% decrease in productive nests; altered courtship behaviors (mean of dosed birds)	1.6	Blood	1.60	µg/g ww	White Ibis	Frederick and Jayasena (2010)[a]	na
Reproduction	30% reduction in probability of nest success	1.7	Blood	1.70	µg/g ww	Carolina Wren	Jackson et al. (2011)	na
Reproduction	Impaired reproduction	1.8	Egg	0.80	µg/g ww	Mallard	Heinz (1979)[a]	3
Reproduction	23% reduction in max. productivity	2.0	Blood	2.00	µg/g ww	Common Loon	Burgess and Meyer (2008)	na
Health and physiology	Proposed concentration for adverse effects in waterbirds (review)	2.0	Liver	5.00	µg/g ww	Multiple	Zillioux et al. (1993)	1
Reproduction	Impaired productivity (review)	2.1	Diet (fish)	0.18	µg/g ww	Common Loon	Depew et al. (2012)	4
Reproduction	Probability of successfully raising 2 chicks the subsequent year drops below 50%	2.1	RBCs	10.00	µg/g dw	Brown Skua	Goutte et al. (2014)	2
Reproduction	40% reduction in probability of nest success	2.1	Blood	2.10	µg/g ww	Carolina Wren	Jackson et al. (2011)	na
Reproduction	General impaired hatchability and embryonic mortality (review)	2.3	Egg	1.00	µg/g fww	Multiple	Scheuhammer et al. (2007)	3
Reproduction	Egg hatchability: LC_{50} of egg-injected birds ranked as moderate sensitivity to MeHg	2.3	Egg	1.00	µg/g ww	Multiple	Heinz et al. (2009a)[a]	3
Reproduction	50% reduction in probability of nest success	2.5	Blood	2.50	µg/g ww	Carolina Wren	Jackson et al. (2011)	na

Reproduction	Egg hatchability: LC_{50} of egg-injected and maternally derived MeHg	2.5	Egg	1.10	µg/g ww	Arctic Tern	Braune et al. (2012)[a]	3
Reproduction	10% probability of embryo being malpositioned in egg	2.7	Egg	1.20	µg/g fww	Forster's Tern	Herring et al. (2010)	3
Reproduction	Impaired productivity	2.8	Diet (fish)	0.30	µg/g ww	Common Loon	Barr (1986)	4
Health and physiology	Decreased immunocompetence (mean of contaminated site)	2.9	Blood	2.85	µg/g ww	Tree Swallow	Hawley et al. (2009)	na
Reproduction	35% reduction in max. productivity	3.0	Blood	3.00	µg/g ww	Common Loon	Burgess and Meyer (2008)	na
Reproduction	Reproductive failure	3.0	Blood	3.00	µg/g ww	Common Loon	Evers et al. (2008)	na
Reproduction	Decreased hatching and fledging success when ambient temps. increased (mean of contaminated site)	3.0	Blood	3.03	µg/g ww	Tree Swallow	Hallinger and Cristol (2011)	na
Health and physiology	Suggested threshold above which demethylation occurs in a dose dependent relationship	3.2	Liver	8.00	µg/g ww	Black-crowned Night-heron, Snowy Egret, Double-crested Cormorant	Henny et al. (2002)	1
Reproduction	20% probability of embryo being malpositioned in egg	3.2	Egg	1.40	µg/g fww	Forster's Tern	Herring et al. (2010)	3
Reproduction	Failed productivity (review)	3.4	Diet (fish)	0.40	µg/g ww	Common Loon	Depew et al. (2012)	4
Reproduction	Severe impaired productivity	3.4	Diet (fish)	0.40	µg/g ww	Common Loon	Barr (1986)	4
Reproduction	Decreased egg hatchability	3.5	Egg	1.50	µg/g ww	Ring-necked Pheasant	Fimreite (1971)	3
Reproduction	Decreased productivity for first time breeding females (in 1 of 2 years of study; mean of contaminated site)	3.6	Blood	3.56	µg/g ww	Tree Swallow	Brasso and Cristol (2008)	na
Reproduction	30% probability of embryo being malpositioned in egg	3.6	Egg	1.55	µg/g fww	Forster's Tern	Herring et al. (2010)	3

Reproduction	14% decrease in productive nests; altered courtship behaviors; higher proportion of same sex nest pairs (mean of dosed birds)	4.0	Blood	3.95	µg/g ww	White Ibis	Frederick and Jayasena (2010)[a]	na
Reproduction	40% probability of embryo being malpositioned in egg	4.0	Egg	1.69	µg/g fww	Forster's Tern	Herring et al. (2010)	3
Reproduction	46% reduction in max. productivity	4.0	Blood	4.00	µg/g ww	Common Loon	Burgess and Meyer (2008)	na
Reproduction	16% reduction in reproductive success	4.0	Blood	4.00	µg/g ww	Zebra Finch	Varian-Ramos et al. (2014)[a]	na
Reproduction	Egg hatchability: LC_{50} of egg-injected and maternally derived MeHg	4.2	Egg	1.78	µg/g ww	Common Loon	Kenow et al. (2011)[a]	3
Reproduction	Egg hatchability: LC_{50} of egg-injected birds ranked as low sensitivity to MeHg	4.2	Egg	1.79	µg/g ww	Multiple	Heinz et al. (2009a)[a]	3
Reproduction	50% probability of embryo being malpositioned in egg	4.3	Egg	1.82	µg/g fww	Forster's Tern	Herring et al. (2010)	3
Reproduction	50% reduction in max. productivity	4.3	Blood	4.30	µg/g ww	Common Loon	Burgess and Meyer (2008)	na
Reproduction	Decreased egg hatchability (mean of contaminated site)	4.3	Egg	7.34	µg/g dw	Tree Swallow	Custer et al. (2007)	3
Health and physiology	Glutathione metabolism and antioxidant activity (effect on associated enzymes below this concentration)[d]	4.6	Liver	35.00	µg/g dw	Surf Scoter	Hoffman et al. (1998)	1
Reproduction	24% decline in young fledged per pair (over this concentration)	4.8	Egg	2.00	µg/g ww	American Kestrel	Albers et al. (2007)[a]	3
Health and physiology	Impaired macrophage phagocytosis (below this concentration)[d]	6.4	Blood	6.40	µg/g ww	Black-footed Albatross	Finkelstein et al. (2007)	na
Reproduction	Decreased offspring survival (mean of dosed birds)	6.6	Muscle	4.50	µg/g ww	Black Duck	Finley and Stendell (1978)[a]	5

Reproduction	31% reduction in reproductive success, greater number of days to renesting (mean of dosed birds)	8.0	Blood	8.00	µg/g ww	Zebra Finch	Varian-Ramos et al. (2014)[a]	na
Health and physiology	Glutathione metabolism and antioxidant activity (effect on associated enzymes below this concentration)[d]	8.5	Liver	66.00	µg/g dw	Greater Scaup	Hoffman et al. (1998)	1
Mortality	Proposed indicative concentration for death (review)	8.5	Liver	22.00	µg/g ww	Multiple	Shore et al. (2011)	1
Health and physiology	Effects on some bioindicators of oxidative stress (below this concentration)[d]	8.8	Liver	69.00	µg/g dw	Forster's Tern, Caspian Tern	Hoffman et al. (2011)	1
Reproduction	Decreased offspring survival (mean of dosed birds)	9.0	Liver	23.10	µg/g ww	Black Duck	Finley and Stendell (1978)[a]	1
Reproduction	Reproductive impairment (mean from lake with decreased reproduction)	9.1	Egg	3.65	µg/g ww	Common Tern	Fimreite (1974)	3
Health and physiology	Decreased energy expenditure for flight takeoff; altered molt sequence (mean of dosed birds)	9.8	Blood	9.80	µg/g ww	European Starling	Carlson et al. (2014)[a]	na
Mortality	Proposed concentration for mercury toxicity (review)	11.5	Liver	30.00	µg/g ww	Multiple	Thompson (1996)	1
Reproduction	Lethality to embryo (mean of eggs from dosed females)	13.0	Egg	5.10	µg/g ww	Black Duck	Finley and Stendell (1978)[a]; from Shore et al. (2011)	3
Behavioral	Mass loss and altered foraging behavior in response to simulated predator (mean of dosed birds)	13.9	Blood	13.93	µg/g ww	Zebra Finch	Kobiela et al. (2015)[a]	na
Behavioral	Visible neurotoxicity; impaired movement (mean of dosed birds)	16.4	Liver	43.00	µg/g ww	Zebra Finch	Scheuhammer (1988)[a]	1[e]
Reproduction	42% reduction in reproductive success, greater number of days to renesting (mean of dosed birds)	17.0	Blood	17.00	µg/g ww	Zebra Finch	Varian-Ramos et al. (2014)[a]	na

Mortality	Death; swelling of axons; loss of myelin (below this concentration)[d]	18.1	Muscle	11.40	µg/g	Red-tailed Hawk	Fimreite and Karstad (1971)[a]	5[e]
Mortality	Death (mean concentration for dead birds: review)	23.7	Liver	63.00	µg/g ww	Multiple	Shore et al. (2011)	1[e]
Health and physiology	Decreased enzymes associated with oxidative stress (mean of dosed birds)	24.4	Liver	65.00	µg/g ww	Mallard	Hoffman and Heinz (1998)[a]	1[e]
Mortality	Death (mean of dosed birds that died)	27.3	Liver	73.00	µg/g ww	Zebra Finch	Scheuhammer (1988)[a]	1[e]
Reproduction	50% reduction in reproductive success, greater number of days to renesting (mean of dosed birds)	31.0	Blood	31.00	µg/g ww	Zebra Finch	Varian-Ramos et al. (2014)[a]	na
Health and physiology	Acute inflammatory response; physiological stress (mean of dosed birds)	41.7	Blood	41.71	µg/g ww	American Kestrel	Fallacara et al. (2011)[a]	na
Mortality	Visible neurotoxicity; some death (mean of dosed birds)	45.0	Blood	45.00	µg/g ww	American Kestrel	Bennett et al. (2009)[a]	na
Health and physiology	Effects on brain neurotransmitters (below this concentration)[d]	48.2	Liver	397.00	µg/g dw	Bald Eagle	Scheuhammer et al. (2008)	1[e]
Mortality	Death (mean of dosed birds that died)	51.4	Muscle	30.00	µg/g ww	Grackle	Finley et al. (1979)[a]	5[e]
Mortality	Death (mean of dosed birds that died)	54.2	Muscle	31.50	µg/g ww	Cowbird	Finley et al. (1979)[a]	5[e]
Health and physiology	Decreased ability to mount a stress response (below this concentration)[d]	57.0	Blood	57.00	µg/g ww	Zebra Finch	Moore et al. (2014)[a]	na
Health and physiology	Effects on brain neurotransmitters (below this concentration)[d]	65.2	Liver	542.00	µg/g dw	Common Loon	Scheuhammer et al. (2008)	1[e]
Mortality	Death (mean of dosed birds that died)	71.4	Muscle	40.70	µg/g ww	Starling	Finley et al. (1979)[a]	5[e]
Mortality	Death (mean of dosed birds that died)	94.0	Blood	94.00	µg/g ww	American Kestrel	Bennett et al. (2009)[a]	na

Mortality	Death (mean of dosed birds that died)	103.0	Muscle	57.10	µg/g ww	Redwing Blackbird	Finley et al. (1979)[a]	5[e]

[a] Indicates a captive feeding study with dosed birds.

[b] Equations used to translate toxicity benchmark to bird blood-equivalent units:

(eq 1) $\ln\left(Blood\ THg\ \frac{\mu g}{g}_{ww}\right) = 0.970 \times \ln\left(Bird\ Liver\ THg\ \frac{\mu g}{g}_{dw}\right) - 1.929$ ($R^2 = 0.88$; Eagles-Smith et al., 2008)

(eq 2) Results for THg concentrations in red blood cells were reported as µg/g dw, without any estimate of percent moisture available. Therefore, a percent moisture of 79% (see Eagles-Smith et al., 2008) was assumed to convert µg/g dw to µg/g ww.

(eq 3) $\ln\left(Female\ Bird\ Blood\ THg\ \frac{\mu g}{g}_{ww}\right) = 1.0734 \times \ln\left(Egg\ THg\ \frac{\mu g}{g}_{fww}\right) + 0.8149$ ($R^2 = 0.95$; Ackerman et al., 2016a)

(eq 4) $\ln\left(Female\ Bird\ Blood\ THg\ \frac{\mu g}{g}_{ww}\right) = 0.6182 \times \ln\left(Prey\ Fish\ THg\ \frac{\mu g}{g}_{ww}\right) + 1.788$ (Ackerman et al., 2015)

(eq 5) $\ln\left(Blood\ THg\ \frac{\mu g}{g}_{ww}\right) = 1.080 \times \ln\left(Bird\ Muscle\ THg\ \frac{\mu g}{g}_{dw}\right) - 1.024$ ($R^2 = 0.90$; Eagles-Smith et al., 2008)

[c] Moisture content from the study was used if reported. If it was not reported, a moisture content of 67% in liver, 75% in eggs, 70% in muscle, and 79% in blood was used (Eagles-Smith et al., 2008). If wet weight vs dry weight was not reported, wet weight (muscle) was assumed.

[d] For correlative studies with a relationship between THg concentration and an effect, the highest observed THg concentration was reported and stated that the relationship was observed "below this concentration."

[e] THg concentrations in these captive studies had highly-dosed birds with liver or muscle THg concentrations outside of the range of data used to generate the equations to translate tissue THg concentrations to blood-equivalent units, and blood-equivalent THg concentrations should be interpreted with caution.

Table 2. Suggested tissues for sampling bird mercury contamination.

Priority	Age	Tissue	Mercury Analysis	Most THg in MeHg form?	Units	Represents	Reference
High	Adult	Blood	THg	Yes	wet weight or dry weight	Hg in adult and egg (if a breeding female)	Henny et al. (2002); Evers et al. (2003); Rimmer et al. (2005); Eagles-Smith et al. (2008); Brasso et al. (2010); Heinz et al. (2010); Kenow et al. (2015); Ou et al. (2015); Ackerman et al. (2016a)
High	Egg	Eggs	THg	Yes	fresh wet weight	Hg in egg and adult; direct link to reproduction	Ackerman et al. (2013); Ackerman et al. (2016a)
High	Chick	Feathers (down)	THg	Yes	dry weight	Hg in egg; highly correlated	Ackerman and Eagles-Smith (2009); Kenow et al. (2011)
Moderate	Egg	Egg albumen	THg	Yes	wet weight	Hg in whole egg; direct link to reproduction	Kennamer et al. (2005); Bond and Diamond (2009); Stebbins et al. (2009)
Moderate	Adult	Muscle	THg	Yes	dry weight	Hg in adult and egg (if a breeding female)	Finley and Stendell (1978); Scheuhammer et al. (1998); Eagles-Smith et al. (2008); Ackerman et al. (2016a)
Moderate	Adult	Liver	MeHg	No	dry weight	Hg in adult and egg (if a breeding female)	Finley and Stendell (1978); Henny et al. (2002); Eagles-Smith et al. (2008); Eagles-Smith et al. (2009b); Ackerman et al. (2016a)
Moderate	Adult	Kidney	MeHg	No	dry weight	Hg in adult and egg (if a breeding female)	Finley and Stendell (1978); Henny et al. (2002); Eagles-Smith et al. (2008); Ackerman et al. (2016a)
Moderate	Adult	Brain	MeHg	No	dry weight	Hg in adult	Finley and Stendell (1978); Scheuhammer et al. (2008)

Low	Adult	Feathers (fully-grown)	THg	Yes	dry weight	Poor correlation with Hg in internal tissues and eggs for most birds; exceptions are for species with limited movements	Thompson and Furness (1989); Brasso and Cristol (2008); Eagles-Smith et al. (2008); Jackson et al. (2011); Ackerman et al. (2012); Ackerman et al. (2016a)
Low	Egg	Egg yolk	THg	Yes	wet weight	Hg in whole egg; moderate correlation	Kennamer et al. (2005); Bond and Diamond (2009)
Low	Egg	Egg shell	THg	Unknown	dry weight	Hg in whole egg; moderate correlation	Kennamer et al. (2005)
Low	Chick	Blood	THg	Yes	wet weight or dry weight	Hg changes rapidly with chick age	Kenow et al. (2007); Ackerman et al. (2011)
Extra Low	Chick	Feathers (fully-grown)	THg	Yes	dry weight	Very poor correlation with Hg in internal tissues	Ackerman et al. (2009)
Extra Low	Adult	Feathers (primary flight feathers)	THg	Yes	dry weight	Very poor correlation with Hg in internal tissues; large variability among feathers and along length of feather	Furness et al. (1986); Braune and Gaskin (1987); Braune et al. (1987); Dauwe et al. (2003)

Supplementary Materials

Avian mercury exposure and toxicological risk across western North America: a synthesis

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Pages: 73

Figures: 14

Tables: 9

Please note that in the Supplementary Tables, species are listed alphabetically by order, family, and then species. In the Supplementary Figures, species are organized by order and then listed from highest to lowest blood-equivalent total mercury concentrations.

Figure S1. Least squares (LS) mean ± standard error blood-equivalent total mercury (THg) concentrations in western North American birds using raw data. LS mean blood-equivalent THg concentrations were estimated from a model with species as a fixed effect, and grid and year as random effects. Species are organized by order, and then sorted by THg concentrations. Orders in this figure include Falconiformes, Accipitriformes, and Strigiformes.

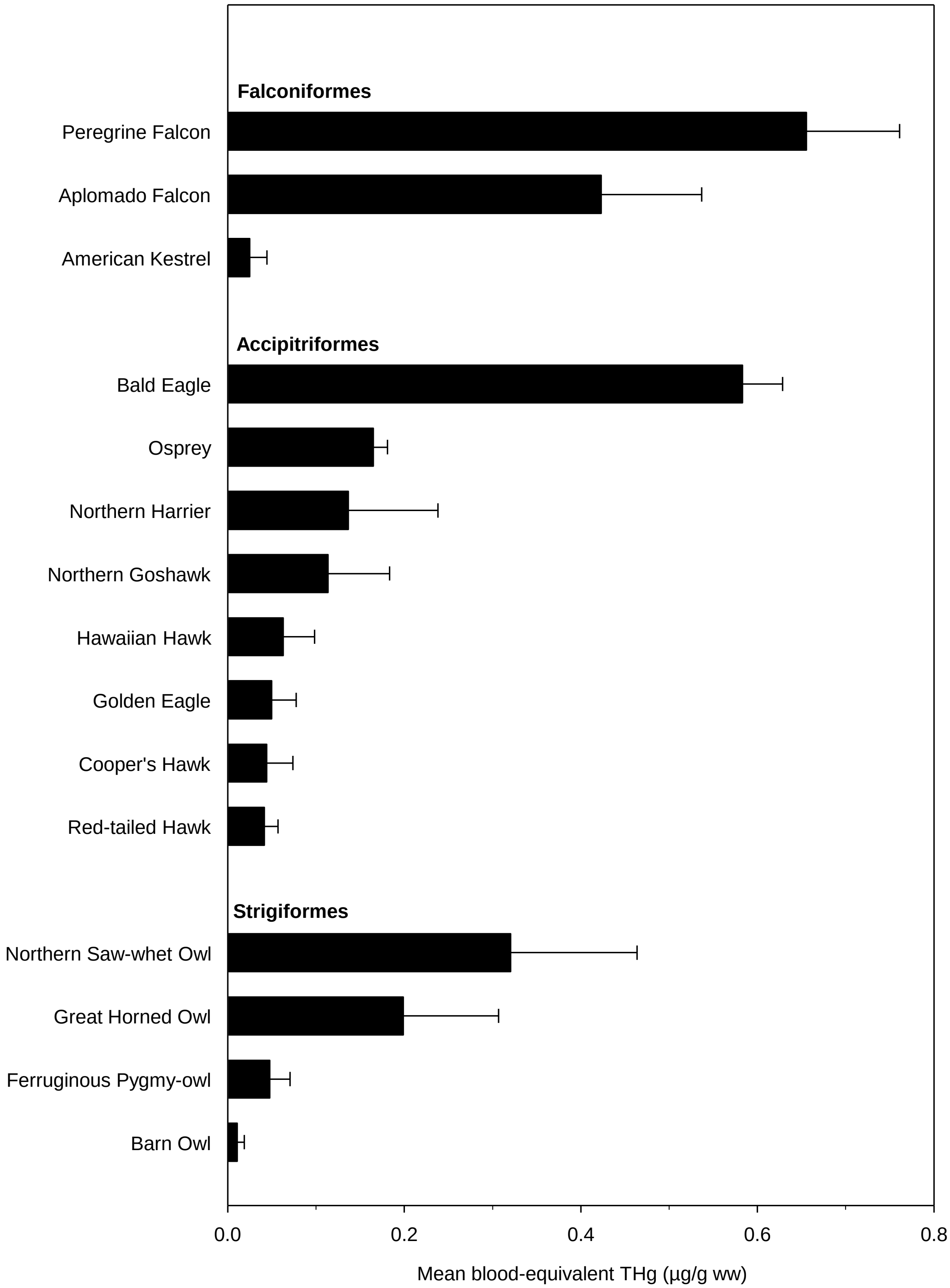

Figure S2. Least squares (LS) mean ± standard error blood-equivalent total mercury (THg) concentrations in western North American birds using raw data. LS mean blood-equivalent THg concentrations were estimated from a model with species as a fixed effect, and grid and year as random effects. Species are organized by order, and then sorted by THg concentrations. Orders in this figure include Podicipediformes, Procellariiformes, and Suliformes.

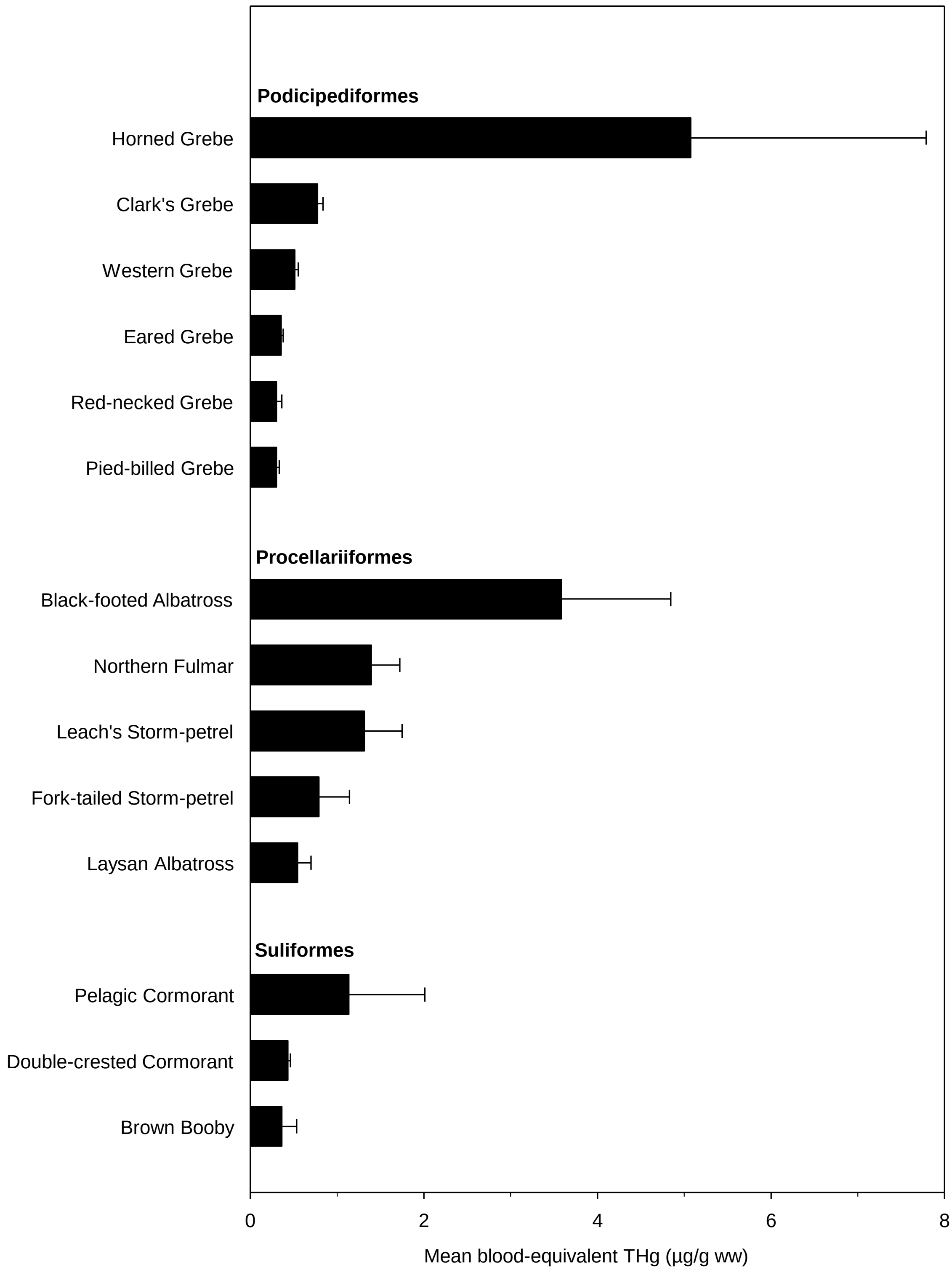

Figure S3. Least squares (LS) mean ± standard error blood-equivalent total mercury (THg) concentrations in western North American birds using raw data. LS mean blood-equivalent THg concentrations were estimated from a model with species as a fixed effect, and grid and year as random effects. Species are organized by order, and then sorted by THg concentrations. Orders in this figure include Gruiformes, Gaviiformes, and Pelecaniformes.

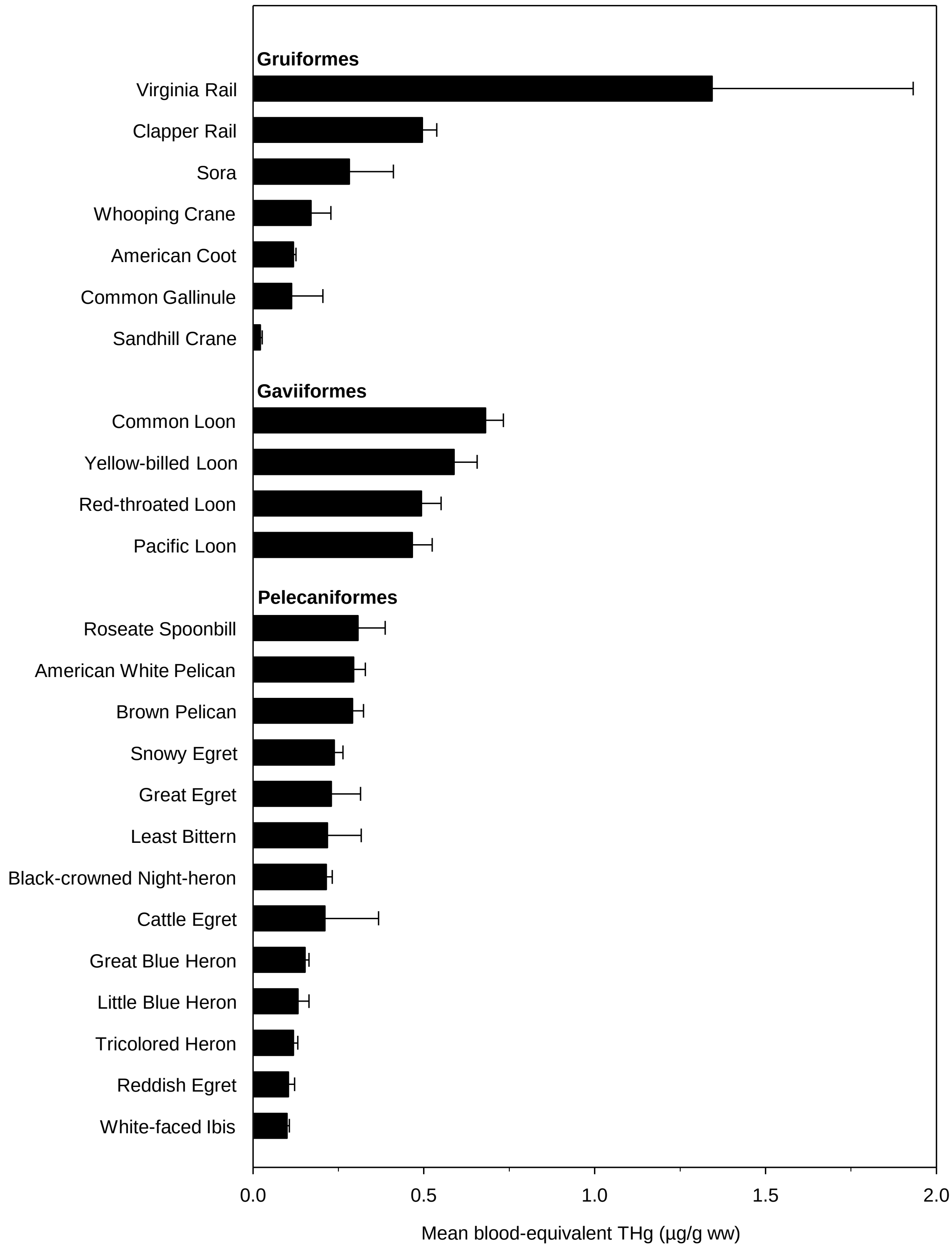

Figure S4. Least squares (LS) mean ± standard error blood-equivalent total mercury (THg) concentrations in western North American birds using raw data. LS mean blood-equivalent THg concentrations were estimated from a model with species as a fixed effect, and grid and year as random effects. Species are organized by order, and then sorted by THg concentrations. The order in this figure is Anseriformes.

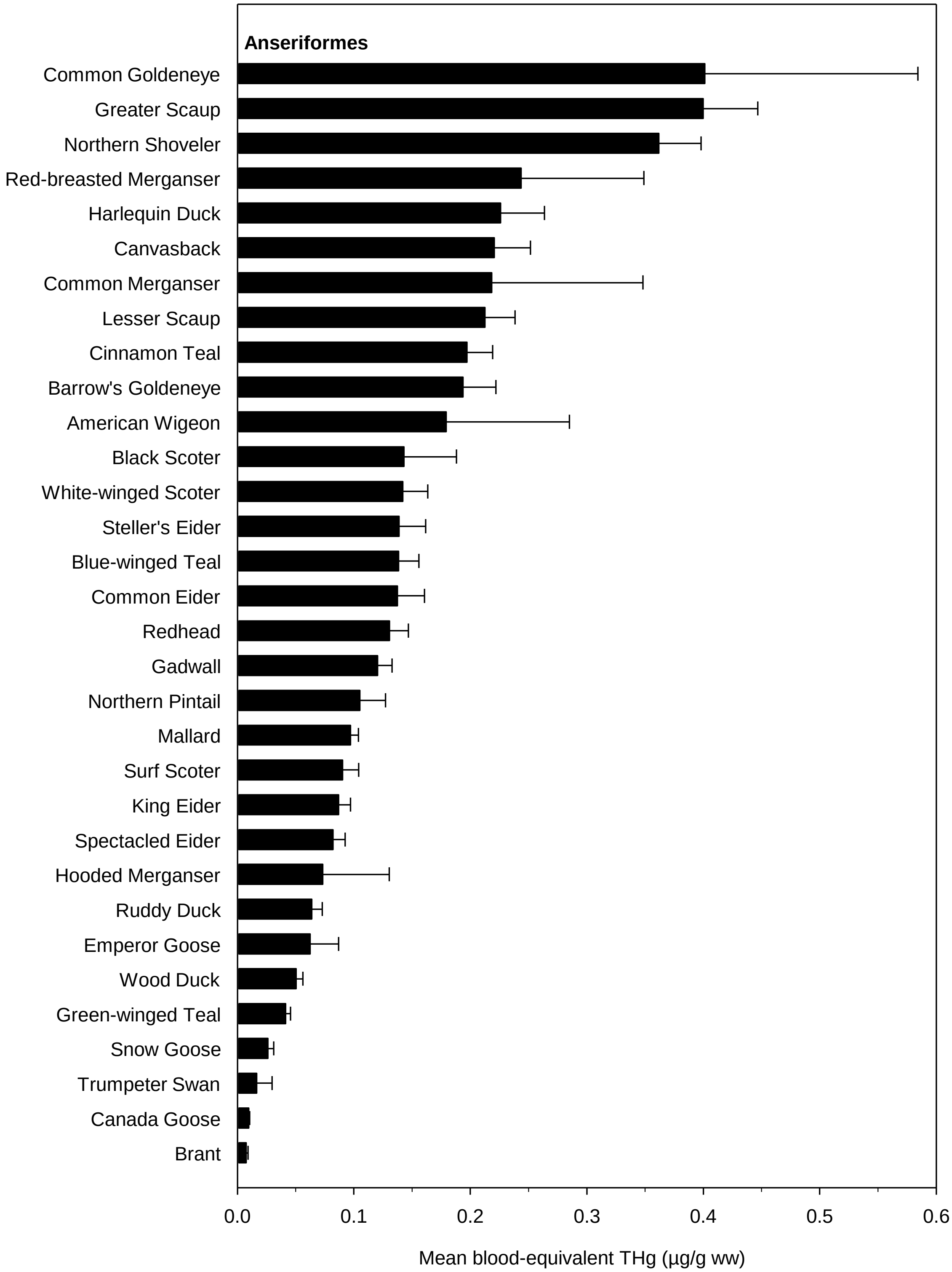

Figure S5. Least squares (LS) mean ± standard error blood-equivalent total mercury (THg) concentrations in western North American birds using raw data. LS mean blood-equivalent THg concentrations were estimated from a model with species as a fixed effect, and grid and year as random effects. Species are organized by order, and then sorted by THg concentrations. The order in this figure is Charadriiformes.

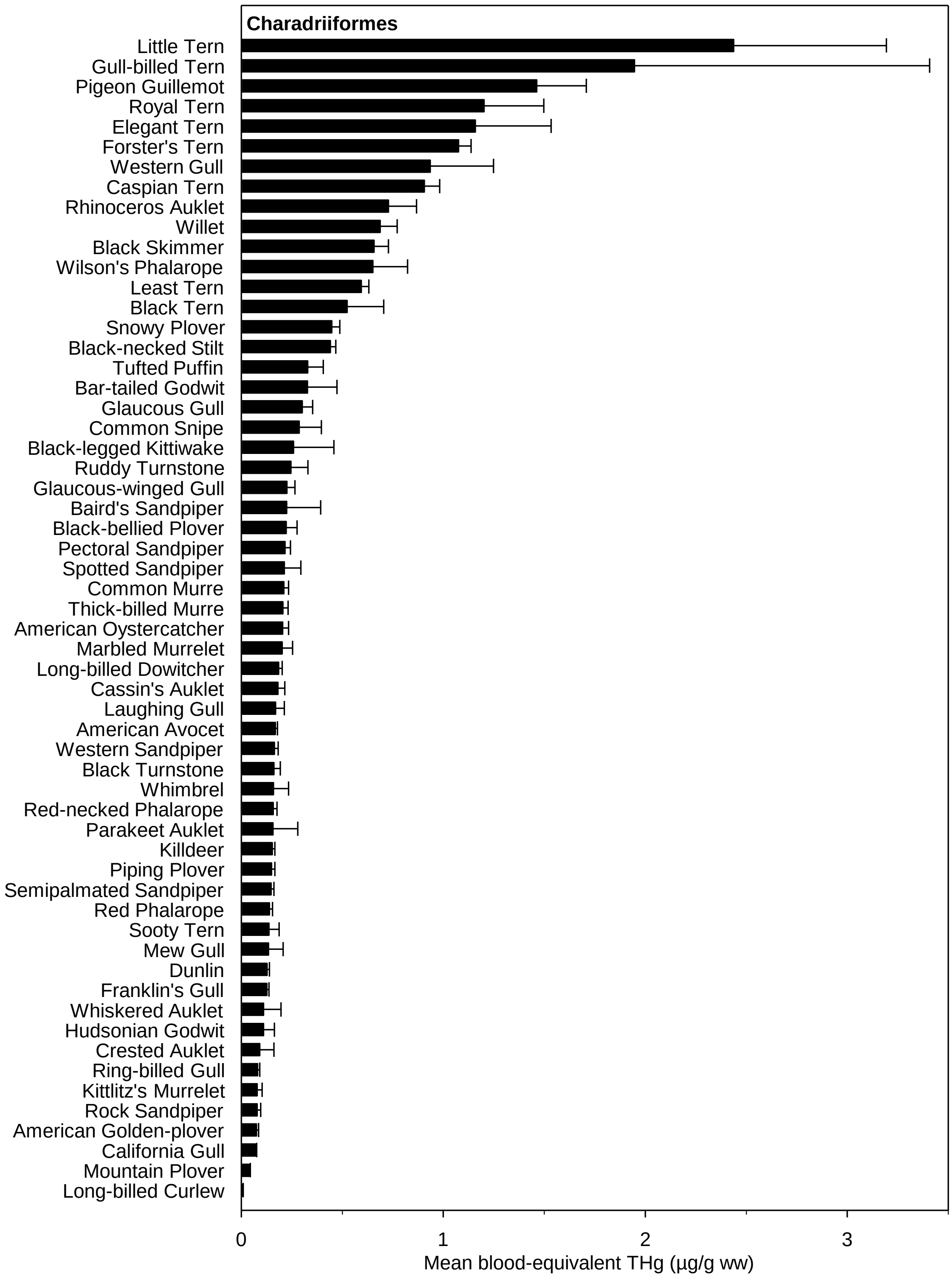

Figure S6. Least squares (LS) mean ± standard error blood-equivalent total mercury (THg) concentrations in western North American birds using raw data. LS mean blood-equivalent THg concentrations were estimated from a model with species as a fixed effect, and grid and year as random effects. Species are organized by order, and then sorted by THg concentrations. The order in this figure is Passeriformes.

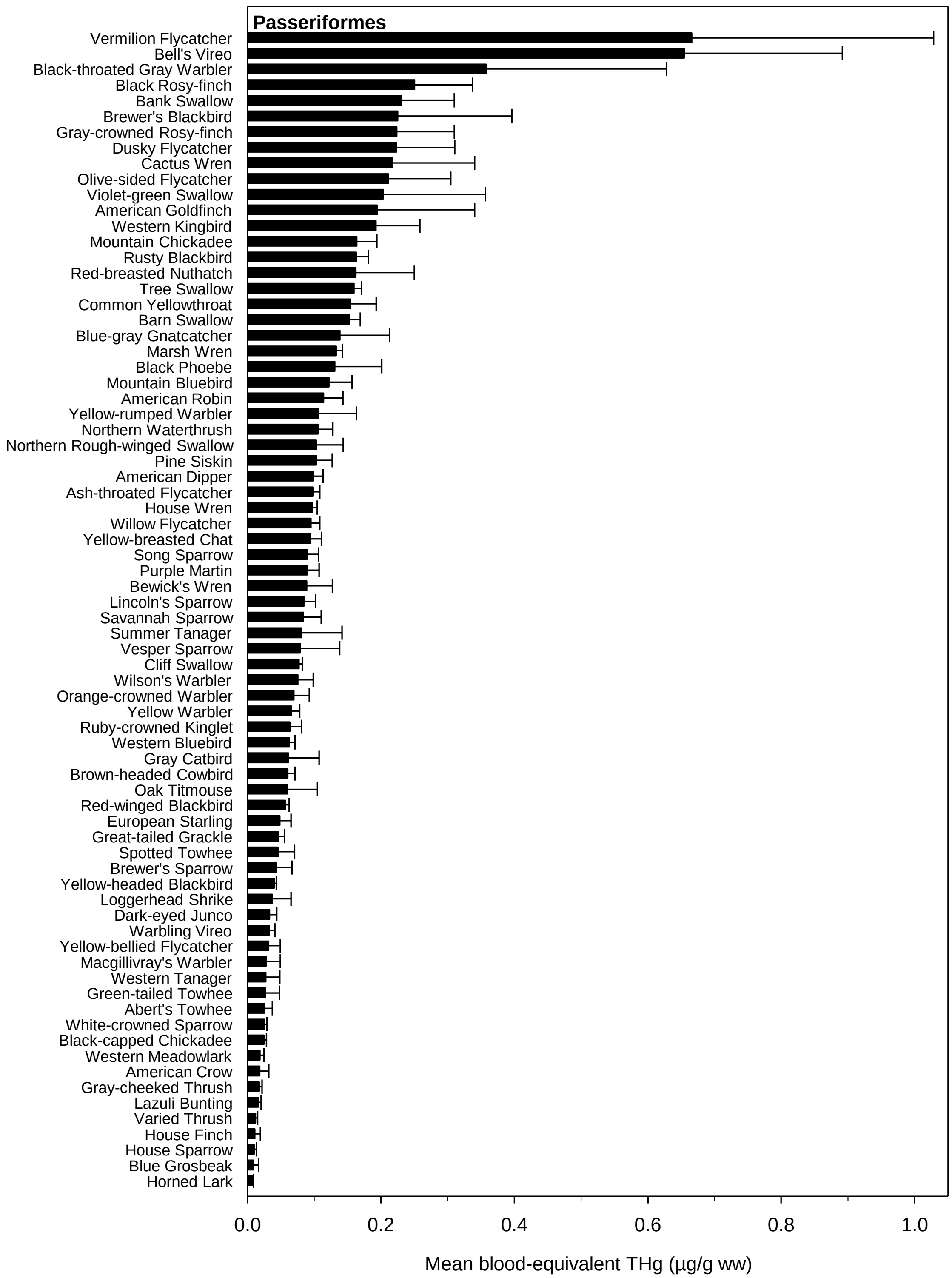

Figure S7. Least squares (LS) mean ± standard error blood-equivalent total mercury (THg) concentrations in western North American birds using raw data. LS mean blood-equivalent THg concentrations were estimated from a model with species as a fixed effect, and grid and year as random effects. Species are organized by order, and then sorted by THg concentrations. Orders in this figure include Piciformes, Galliformes, and Columbiformes.

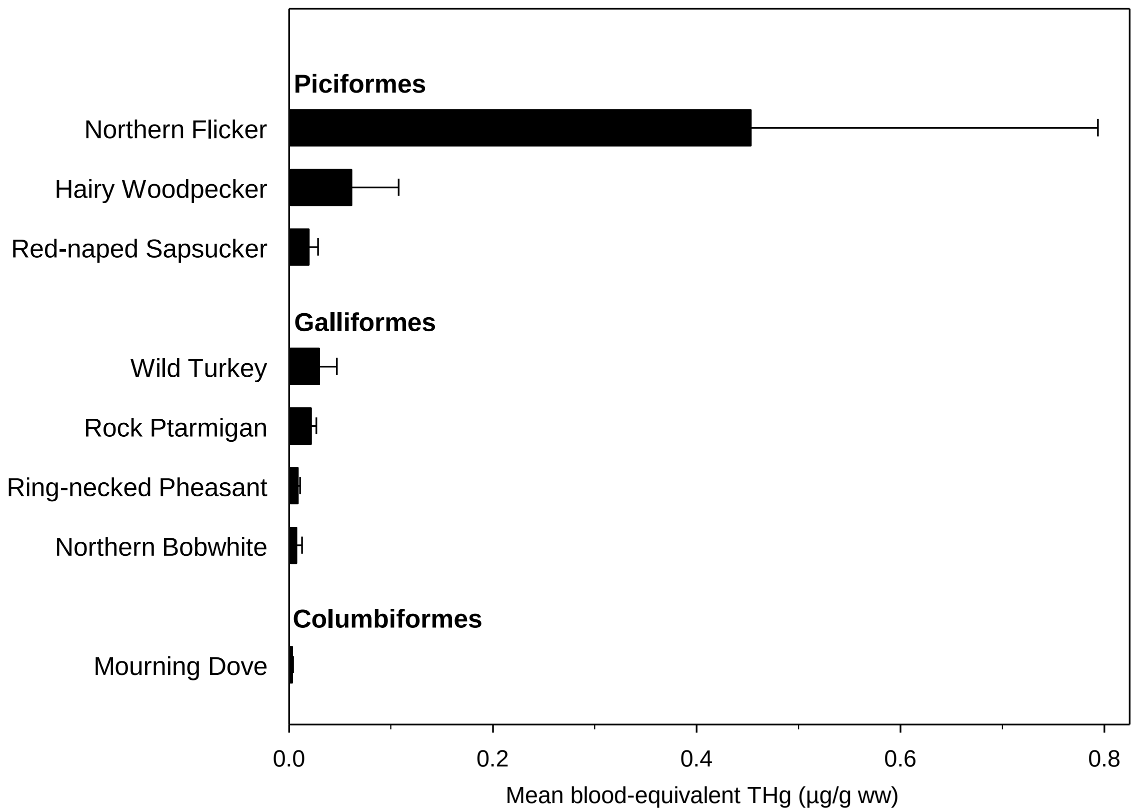

Figure S8. Least squares (LS) mean ± standard error blood-equivalent total mercury (THg) concentrations in western North American birds using data derived from the literature review. LS mean blood-equivalent THg concentrations were estimated from a model with species as a fixed effect, and grid and year as random effects. Species are organized by order, and then sorted by THg concentrations. Orders in this figure include Falconiformes, Accipitriformes, and Strigiformes.

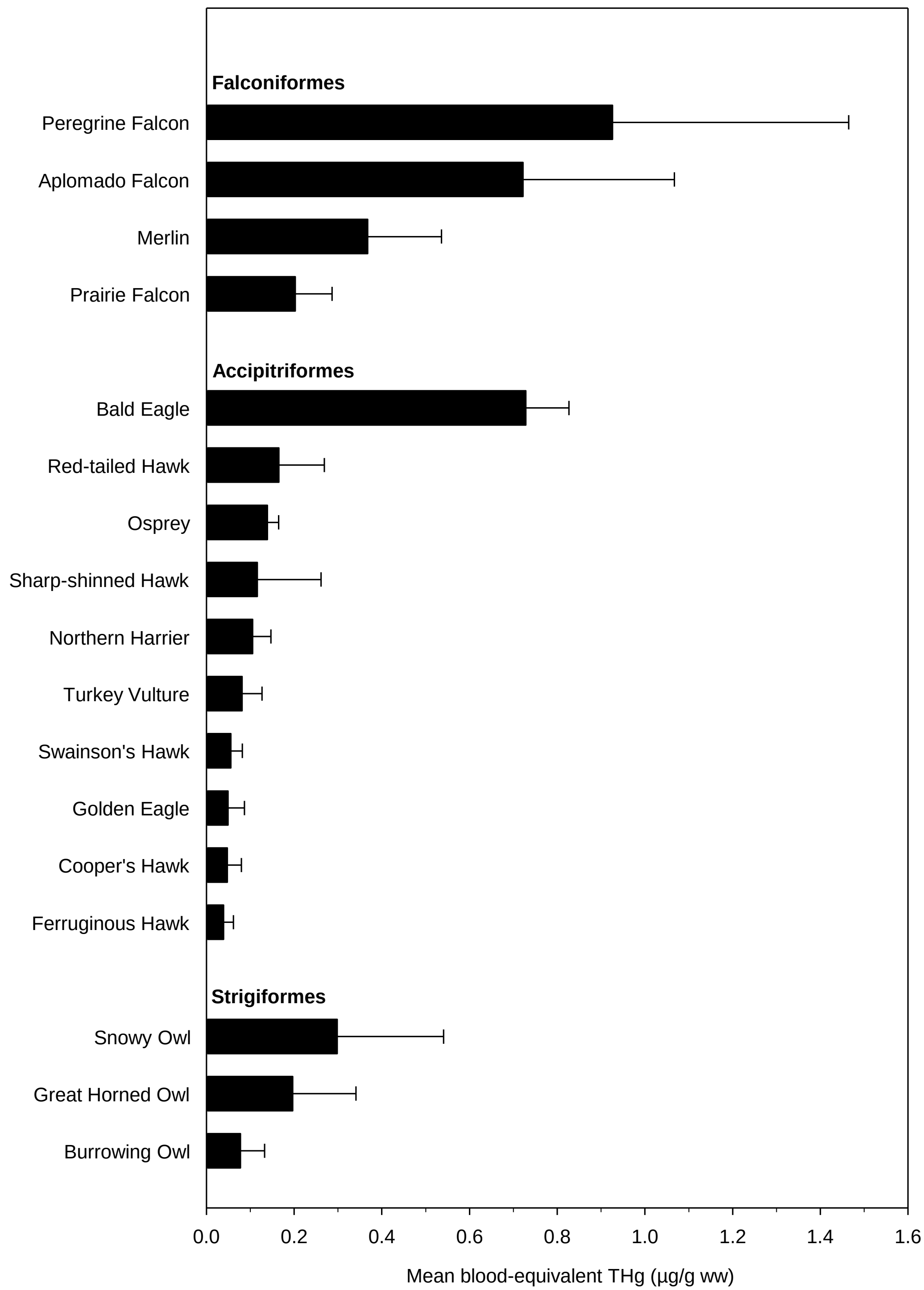

Figure S9. Least squares (LS) mean ± standard error blood-equivalent total mercury (THg) concentrations in western North American birds using data derived from the literature review. LS mean blood-equivalent THg concentrations were estimated from a model with species as a fixed effect, and grid and year as random effects. Species are organized by order, and then sorted by THg concentrations. Orders in this figure include Podicipediformes, Procellariiformes, Suliformes, and Phaethontiformes.

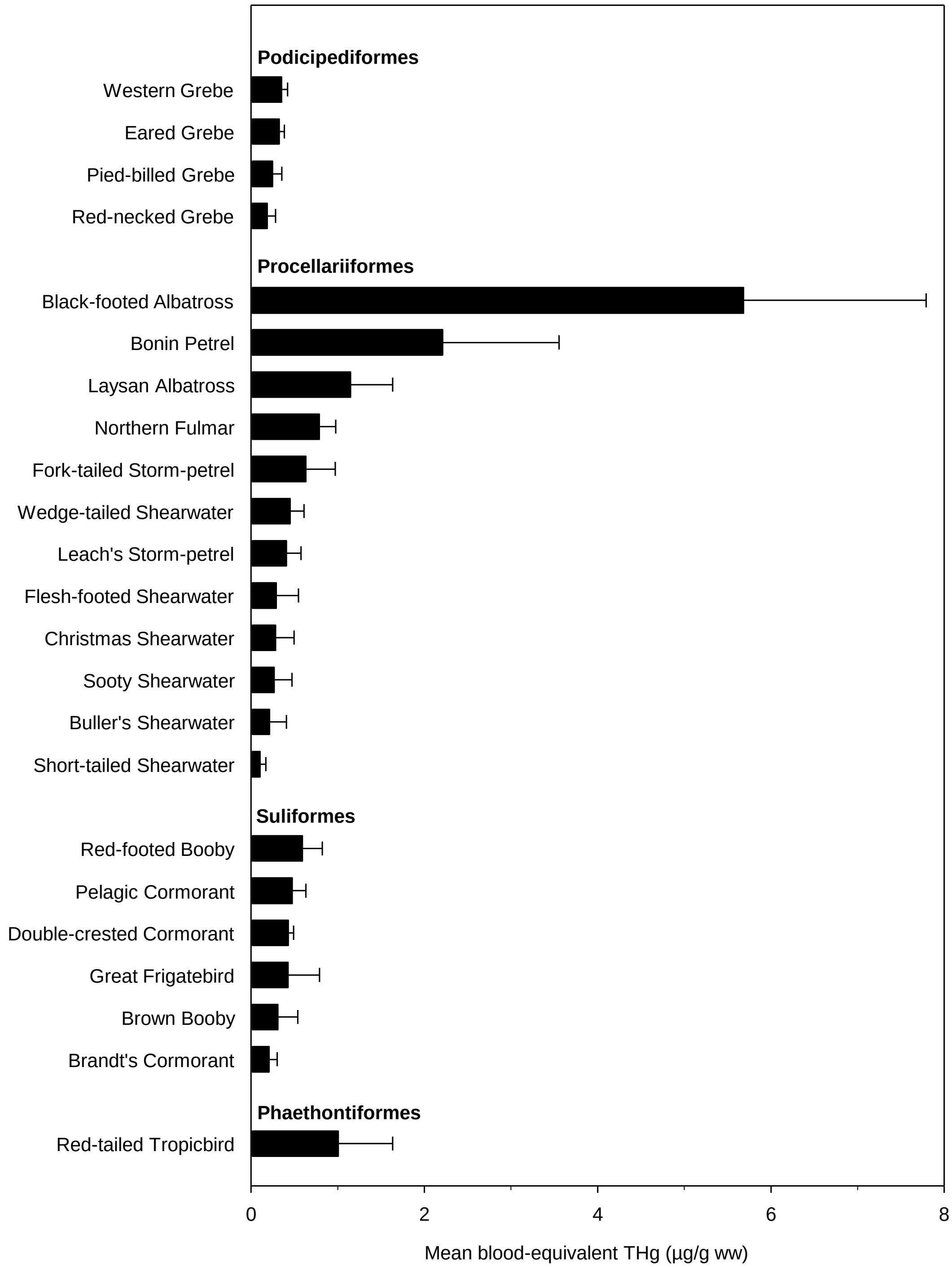

Figure S10. Least squares (LS) mean ± standard error blood-equivalent total mercury (THg) concentrations in western North American birds using data derived from the literature review. LS mean blood-equivalent THg concentrations were estimated from a model with species as a fixed effect, and grid and year as random effects. Species are organized by order, and then sorted by THg concentrations. Orders in this figure include Gruiformes, Gaviformes, and Pelecaniformes.

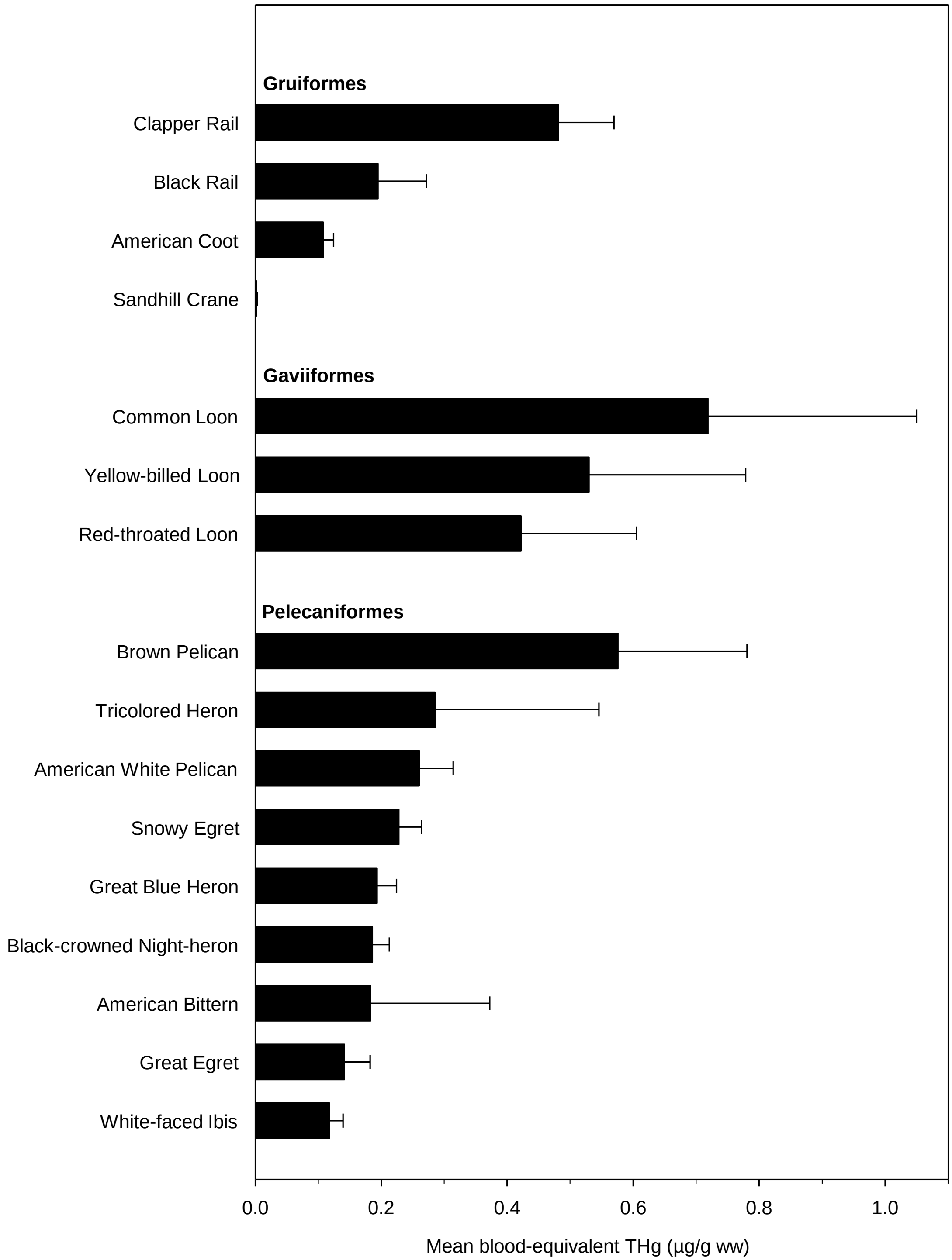

Figure S11. Least squares (LS) mean ± standard error blood-equivalent total mercury (THg) concentrations in western North American birds using data derived from the literature review. LS mean blood-equivalent THg concentrations were estimated from a model with species as a fixed effect, and grid and year as random effects. Species are organized by order, and then sorted by THg concentrations. The order in this figure is Anseriformes.

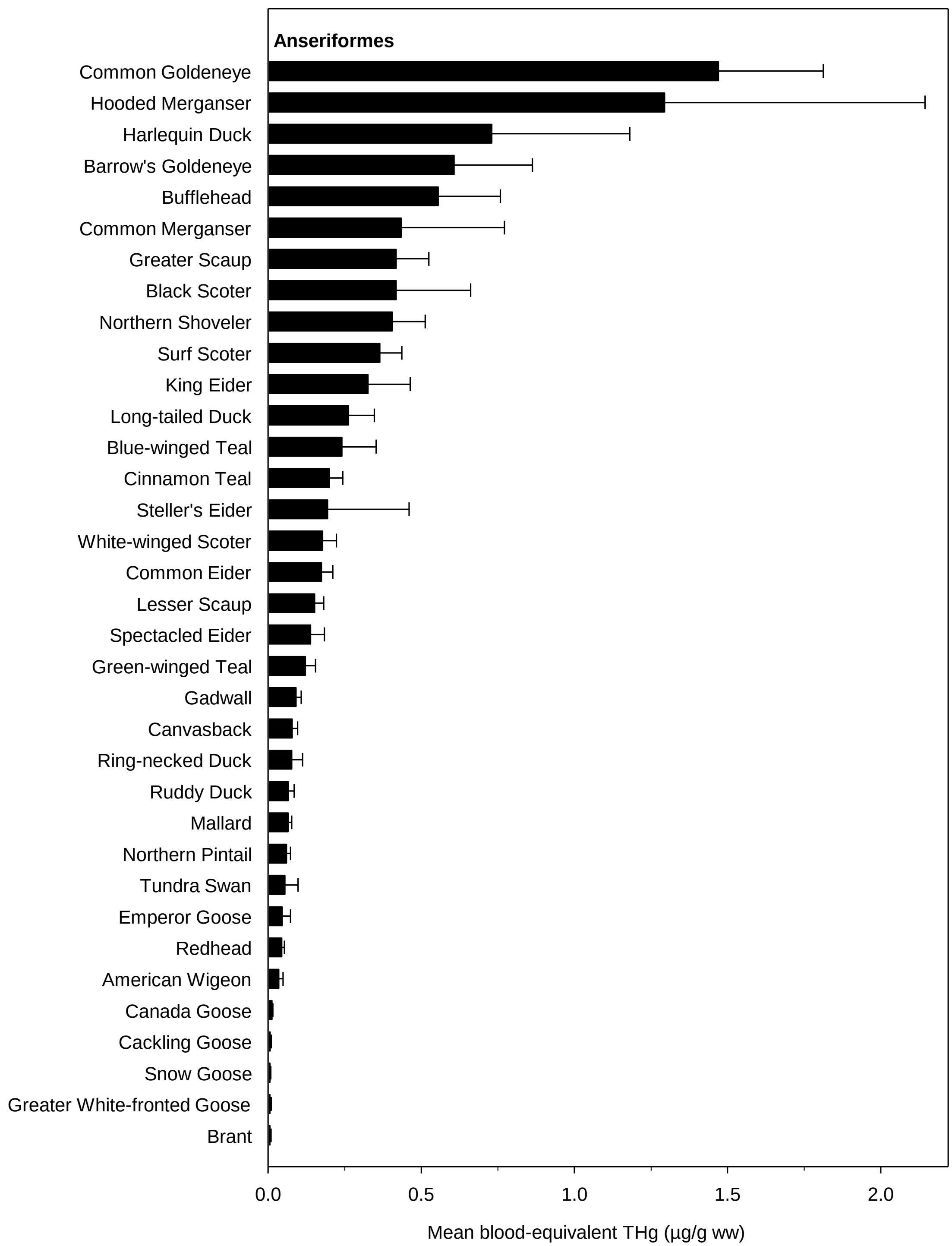

Figure S12. Least squares (LS) mean ± standard error blood-equivalent total mercury (THg) concentrations in western North American birds using data derived from the literature review. LS mean blood-equivalent THg concentrations were estimated from a model with species as a fixed effect, and grid and year as random effects. Species are organized by order, and then sorted by THg concentrations. The order in this figure is Charadriiformes.

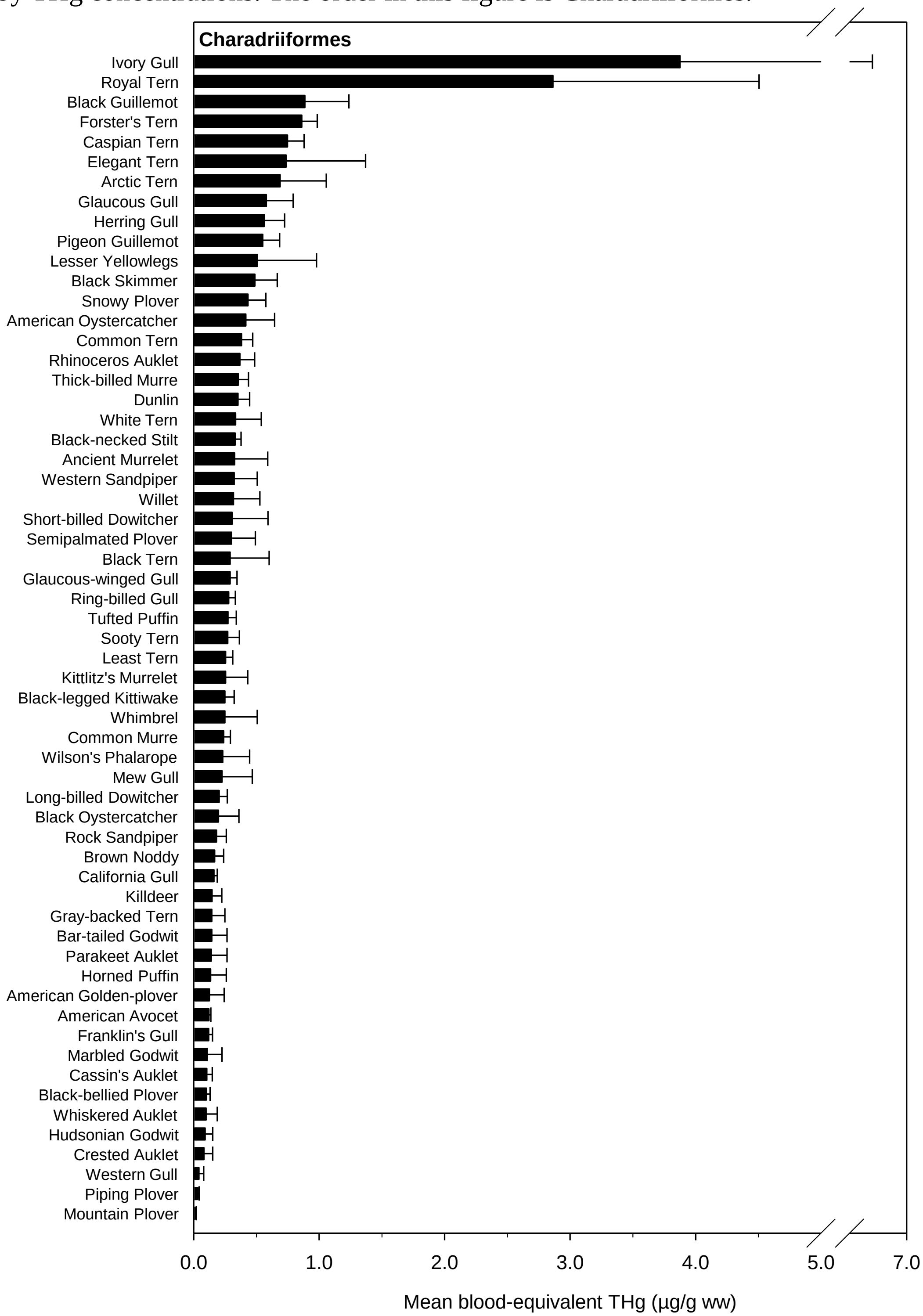

Figure S13. Least squares (LS) mean ± standard error blood-equivalent total mercury (THg) concentrations in western North American birds using data derived from the literature review. LS mean blood-equivalent THg concentrations were estimated from a model with species as a fixed effect, and grid and year as random effects. Species are organized by order, and then sorted by THg concentrations. The order in this figure is Passeriformes.

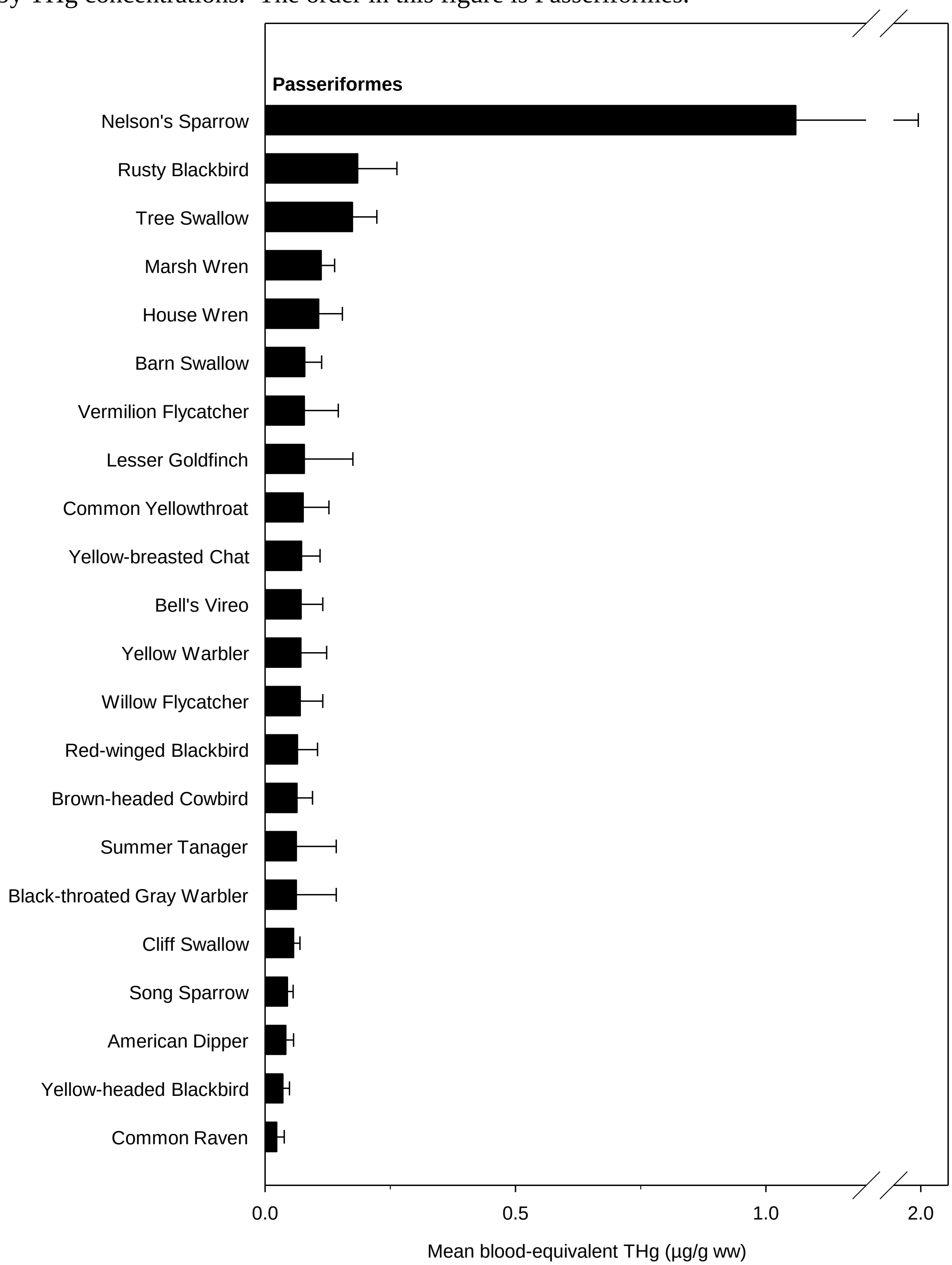

Figure S14. Least squares (LS) mean ± standard error blood-equivalent total mercury (THg) concentrations in western North American birds using data derived from the literature review. LS mean blood-equivalent THg concentrations were estimated from a model with species as a fixed effect, and grid and year as random effects. Species are organized by order, and then sorted by THg concentrations. Orders in this figure include Galliformes and Columbiformes.

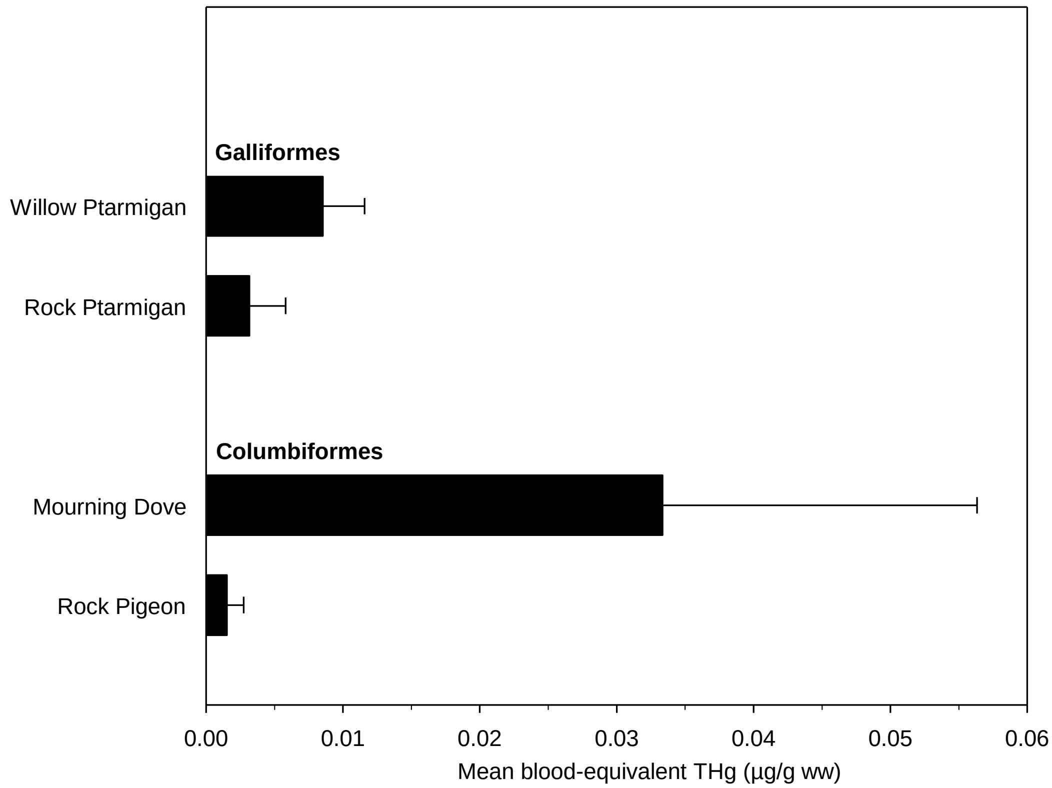

Table S1. Summary of 273 bird species studied for mercury contamination in western North America, and their primary foraging guilds and habitats during the breeding season.

Order	Family	Common name	Species	Foraging guild	Habitat
Accipitriformes					
	Accipitridae				
		Bald Eagle	*Haliaeetus leucocephalus*	Piscivore	Fresh and brackish water
		Cooper's Hawk	*Accipiter cooperii*	Carnivore	Terrestrial-ground
		Ferruginous Hawk	*Buteo regalis*	Carnivore	Terrestrial-ground
		Golden Eagle	*Aquila chrysaetos*	Carnivore	Terrestrial-ground
		Hawaiian Hawk	*Buteo solitarius*	Carnivore	Terrestrial-ground
		Northern Goshawk	*Accipiter gentilis*	Carnivore	Terrestrial-ground
		Northern Harrier	*Circus cyaneus*	Carnivore	Freshwater
		Red-tailed Hawk	*Buteo jamaicensis*	Carnivore	Terrestrial-ground
		Sharp-shinned Hawk	*Accipiter striatus*	Carnivore	Terrestrial-ground
		Swainson's Hawk	*Buteo swainsoni*	Carnivore	Terrestrial-ground
	Cathartidae				
		Turkey Vulture	*Cathartes aura*	Carnivore	Terrestrial-ground
	Pandionidae				
		Osprey	*Pandion haliaetus*	Piscivore	Fresh and brackish water
Anseriformes					
	Anatidae				
		American Wigeon	*Anas americana*	Omnivore	Freshwater
		Barrow's Goldeneye	*Bucephala islandica*	Omnivore	Freshwater
		Black Scoter	*Melanitta americana*	Omnivore	Coastal
		Blue-winged Teal	*Anas discors*	Omnivore	Freshwater
		Brant	*Branta bernicla*	Herbivore	Coastal
		Bufflehead	*Bucephala albeola*	Insectivore	Freshwater
		Cackling Goose	*Branta hutchinsii*	Herbivore	Fresh and brackish water
		Canada Goose	*Branta canadensis*	Herbivore	Freshwater
		Canvasback	*Aythya valisineria*	Omnivore	Freshwater
		Cinnamon Teal	*Anas cyanoptera*	Omnivore	Freshwater
		Common Eider	*Somateria mollissima*	Molluscovore	Coastal
		Common Goldeneye	*Bucephala clangula*	Omnivore	Freshwater
		Common Merganser	*Mergus merganser*	Piscivore	Freshwater
		Emperor Goose	*Chen canagica*	Herbivore	Coastal
		Gadwall	*Anas strepera*	Omnivore	Freshwater
		Greater Scaup	*Aythya marila*	Omnivore	Freshwater
		Greater White-fronted Goose	*Anser albifrons*	Herbivore	Coastal
		Green-winged Teal	*Anas crecca*	Omnivore	Freshwater
		Harlequin Duck	*Histrionicus histrionicus*	Insectivore	Freshwater
		Hooded Merganser	*Lophodytes cucullatus*	Piscivore	Freshwater
		King Eider	*Somateria spectabilis*	Molluscovore	Coastal
		Lesser Scaup	*Aythya affinis*	Crustaceovore	Freshwater
		Long-tailed Duck	*Clangula hyemalis*	Omnivore	Coastal
		Mallard	*Anas platyrhynchos*	Omnivore	Freshwater
		Northern Pintail	*Anas acuta*	Omnivore	Freshwater
		Northern Shoveler	*Anas clypeata*	Omnivore	Freshwater
		Red-breasted Merganser	*Mergus serrator*	Piscivore	Freshwater

Table S1. *Species names continued*.

Order	Family	Common name	Species	Foraging guild	Habitat
		Redhead	*Aythya americana*	Herbivore	Freshwater
		Ring-necked Duck	*Aythya collaris*	Omnivore	Freshwater
		Ruddy Duck	*Oxyura jamaicensis*	Omnivore	Freshwater
		Snow Goose	*Chen caerulescens*	Herbivore	Coastal
		Spectacled Eider	*Somateria fischeri*	Molluscovore	Coastal
		Steller's Eider	*Polysticta stelleri*	Molluscovore	Coastal
		Surf Scoter	*Melanitta perspicillata*	Molluscovore	Freshwater
		Trumpeter Swan	*Cygnus buccinator*	Herbivore	Freshwater
		Tundra Swan	*Cygnus columbianus*	Herbivore	Coastal
		White-winged Scoter	*Melanitta fusca*	Molluscovore	Freshwater
		Wood Duck	*Aix sponsa*	Omnivore	Freshwater
Charadriiformes					
	Alcidae				
		Ancient Murrelet	*Synthliboramphus antiquus*	Crustaceovore	Coastal
		Black Guillemot	*Cepphus grylle*	Crustaceovore	Coastal
		Cassin's Auklet	*Ptychoramphus aleuticus*	Crustaceovore	Coastal
		Common Murre	*Uria aalge*	Piscivore	Coastal
		Crested Auklet	*Aethia cristatella*	Crustaceovore	Coastal
		Horned Puffin	*Fratercula corniculata*	Piscivore	Coastal
		Kittlitz's Murrelet	*Brachyramphus brevirostris*	Crustaceovore	Coastal
		Marbled Murrelet	*Brachyramphus marmoratus*	Piscivore	Coastal
		Parakeet Auklet	*Aethia psittacula*	Crustaceovore	Coastal
		Pigeon Guillemot	*Cepphus columba*	Piscivore	Coastal
		Rhinoceros Auklet	*Cerorhinca monocerata*	Crustaceovore	Coastal
		Thick-billed Murre	*Uria lomvia*	Piscivore	Coastal
		Tufted Puffin	*Fratercula cirrhata*	Piscivore	Coastal
		Whiskered Auklet	*Aethia pygmaea*	Crustaceovore	Coastal
	Charadriidae				
		American Golden-plover	*Pluvialis dominica*	Insectivore	Coastal
		Black-bellied Plover	*Pluvialis squatarola*	Crustaceovore	Coastal
		Killdeer	*Charadrius vociferus*	Insectivore	Fresh and brackish water
		Mountain Plover	*Charadrius montanus*	Insectivore	Terrestrial-ground
		Piping Plover	*Charadrius melodus*	Insectivore	Fresh and brackish water
		Semipalmated Plover	*Charadrius semipalmatus*	Molluscovore	Coastal
		Snowy Plover	*Charadrius nivosus*	Crustaceovore	Fresh and brackish water
	Haematopodidae				
		American Oystercatcher	*Haematopus palliatus*	Molluscovore	Coastal
		Black Oystercatcher	*Haematopus bachmani*	Molluscovore	Coastal
	Laridae				
		Arctic Tern	*Sterna paradisaea*	Piscivore	Fresh and brackish water
		Black Skimmer	*Rynchops niger*	Piscivore	Coastal
		Black Tern	*Chlidonias niger*	Insectivore	Freshwater
		Black-legged Kittiwake	*Rissa tridactyla*	Piscivore	Coastal

Table S1. *Species names continued*.

Order	Family	Common name	Species	Foraging guild	Habitat
		Brown Noddy	*Anous stolidus*	Piscivore	Coastal
		California Gull	*Larus californicus*	Insectivore	Fresh and brackish water
		Caspian Tern	*Hydroprogne caspia*	Piscivore	Fresh and brackish water
		Common Tern	*Sterna hirundo*	Piscivore	Coastal
		Elegant Tern	*Thalasseus elegans*	Piscivore	Coastal
		Forster's Tern	*Sterna forsteri*	Piscivore	Fresh and brackish water
		Franklin's Gull	*Leucophaeus pipixcan*	Insectivore	Freshwater
		Glaucous Gull	*Larus hyperboreus*	Piscivore	Coastal
		Glaucous-winged Gull	*Larus glaucescens*	Piscivore	Coastal
		Gray-backed Tern	*Onychoprion lunatus*	Piscivore	Coastal
		Gull-billed Tern	*Gelochelidon nilotica*	Insectivore	Coastal
		Herring Gull	*Larus argentatus*	Piscivore	Coastal
		Ivory Gull	*Pagophila eburnea*	Carnivore	Coastal
		Laughing Gull	*Leucophaeus atricilla*	Crustaceovore	Coastal
		Least Tern	*Sternula antillarum*	Piscivore	Fresh and brackish water
		Little Tern	*Sternula albifrons*	Piscivore	Fresh and brackish water
		Mew Gull	*Larus canus*	Insectivore	Fresh and brackish water
		Ring-billed Gull	*Larus delawarensis*	Piscivore	Freshwater
		Royal Tern	*Thalasseus maximus*	Piscivore	Coastal
		Sooty Tern	*Onychoprion fuscatus*	Piscivore	Coastal
		Western Gull	*Larus occidentalis*	Piscivore	Coastal
		White Tern	*Gygis alba*	Piscivore	Coastal
	Recurvirostridae				
		American Avocet	*Recurvirostra americana*	Omnivore	Fresh and brackish water
		Black-necked Stilt	*Himantopus mexicanus*	Insectivore	Freshwater
	Scolopacidae				
		Baird's Sandpiper	*Calidris bairdii*	Insectivore	Coastal
		Bar-tailed Godwit	*Limosa lapponica*	Insectivore	Coastal
		Black Turnstone	*Arenaria melanocephala*	Molluscovore	Coastal
		Common Snipe	*Gallinago gallinago*	Vermivore	Freshwater
		Dunlin	*Calidris alpina*	Insectivore	Coastal
		Hudsonian Godwit	*Limosa haemastica*	Insectivore	Coastal
		Lesser Yellowlegs	*Tringa flavipes*	Insectivore	Freshwater
		Long-billed Curlew	*Numenius americanus*	Omnivore	Freshwater
		Long-billed Dowitcher	*Limnodromus scolopaceus*	Insectivore	Coastal
		Marbled Godwit	*Limosa fedoa*	Insectivore	Freshwater
		Pectoral Sandpiper	*Calidris melanotos*	Insectivore	Coastal
		Red Phalarope	*Phalaropus fulicarius*	Insectivore	Coastal
		Red-necked Phalarope	*Phalaropus lobatus*	Insectivore	Freshwater
		Rock Sandpiper	*Calidris ptilocnemis*	Insectivore	Coastal
		Ruddy Turnstone	*Arenaria interpres*	Omnivore	Coastal
		Semipalmated Sandpiper	*Calidris pusilla*	Insectivore	Coastal
		Short-billed Dowitcher	*Limnodromus griseus*	Insectivore	Coastal
		Spotted Sandpiper	*Actitis macularius*	Insectivore	Freshwater
		Western Sandpiper	*Calidris mauri*	Insectivore	Coastal
		Whimbrel	*Numenius phaeopus*	Omnivore	Fresh and brackish water

Table S1. *Species names continued*.

Order	Family	Common name	Species	Foraging guild	Habitat
		Willet	*Tringa semipalmata*	Insectivore	Freshwater
		Wilson's Phalarope	*Phalaropus tricolor*	Insectivore	Freshwater
Columbiformes					
	Columbidae				
		Mourning Dove	*Zenaida macroura*	Granivore	Terrestrial-ground
		Rock Pigeon	*Columba livia*	Omnivore	Terrestrial-ground
Falconiformes					
	Falconidae				
		American Kestrel	*Falco sparverius*	Insectivore	Terrestrial-ground
		Aplomado Falcon	*Falco femoralis*	Carnivore	Terrestrial-ground
		Merlin	*Falco columbarius*	Carnivore	Terrestrial-ground
		Peregrine Falcon	*Falco peregrinus*	Carnivore	Terrestrial-ground
		Prairie Falcon	*Falco mexicanus*	Carnivore	Terrestrial-ground
Galliformes					
	Odontophoridae				
		Northern Bobwhite	*Colinus virginianus*	Omnivore	Terrestrial-ground
	Phasianidae				
		Ring-necked Pheasant	*Phasianus colchicus*	Omnivore	Terrestrial-ground
		Rock Ptarmigan	*Lagopus muta*	Herbivore	Terrestrial-ground
		Wild Turkey	*Meleagris gallopavo*	Omnivore	Terrestrial-ground
		Willow Ptarmigan	*Lagopus lagopus*	Herbivore	Terrestrial-ground
Gaviiformes					
	Gaviidae				
		Common Loon	*Gavia immer*	Piscivore	Freshwater
		Pacific Loon	*Gavia pacifica*	Piscivore	Freshwater
		Red-throated Loon	*Gavia stellata*	Piscivore	Coastal
		Yellow-billed Loon	*Gavia adamsii*	Piscivore	Freshwater
Gruiformes					
	Gruidae				
		Sandhill Crane	*Grus canadensis*	Omnivore	Freshwater
		Whooping Crane	*Grus americana*	Omnivore	Freshwater
	Rallidae				
		American Coot	*Fulica americana*	Omnivore	Freshwater
		Black Rail	*Laterallus jamaicensis*	Insectivore	Fresh and brackish water
		Clapper Rail	*Rallus longirostris*	Crustaceovore	Salt Marsh
		Common Gallinule	*Gallinula galeata*	Omnivore	Freshwater
		Sora	*Porzana carolina*	Omnivore	Freshwater
		Virginia Rail	*Rallus limicola*	Insectivore	Freshwater
Passeriformes					
	Alaudidae				
		Horned Lark	*Eremophila alpestris*	Omnivore	Terrestrial-ground
	Cardinalidae				
		Blue Grosbeak	*Passerina caerulea*	Omnivore	Terrestrial-ground
		Lazuli Bunting	*Passerina amoena*	Omnivore	Terrestrial-lower canopy
		Summer Tanager	*Piranga rubra*	Insectivore	Terrestrial-upper canopy
		Western Tanager	*Piranga ludoviciana*	Omnivore	Terrestrial-upper canopy

Table S1. *Species names continued*.

Order	Family	Common name	Species	Foraging guild	Habitat
	Cinclidae				
		American Dipper	*Cinclus mexicanus*	Insectivore	Freshwater
	Corvidae				
		American Crow	*Corvus brachyrhynchos*	Omnivore	Terrestrial-ground
		Common Raven	*Corvus corax*	Omnivore	Terrestrial-ground
	Emberizidae				
		Abert's Towhee	*Melozone aberti*	Omnivore	Terrestrial-ground
		Brewer's Sparrow	*Spizella breweri*	Insectivore	Terrestrial-ground
		Dark-eyed Junco	*Junco hyemalis*	Omnivore	Terrestrial-ground
		Green-tailed Towhee	*Pipilo chlorurus*	Omnivore	Terrestrial-ground
		Lincoln's Sparrow	*Melospiza lincolnii*	Omnivore	Terrestrial-ground
		Nelson's Sparrow	*Ammodramus nelsoni*	Insectivore	Terrestrial-ground
		Savannah Sparrow	*Passerculus sandwichensis*	Omnivore	Terrestrial-ground
		Song Sparrow	*Melospiza melodia*	Omnivore	Freshwater
		Spotted Towhee	*Pipilo maculatus*	Omnivore	Terrestrial-ground
		Vesper Sparrow	*Pooecetes gramineus*	Omnivore	Terrestrial-ground
		White-crowned Sparrow	*Zonotrichia leucophrys*	Omnivore	Terrestrial-ground
	Fringillidae				
		American Goldfinch	*Spinus tristis*	Omnivore	Terrestrial-lower canopy
		Black Rosy-finch	*Leucosticte atrata*	Omnivore	Terrestrial-ground
		Gray-crowned Rosy-finch	*Leucosticte tephrocotis*	Omnivore	Terrestrial-ground
		House Finch	*Haemorhous mexicanus*	Granivore	Terrestrial-ground
		Lesser Goldfinch	*Spinus psaltria*	Granivore	Terrestrial-lower canopy
		Pine Siskin	*Spinus pinus*	Omnivore	Terrestrial-upper canopy
	Hirundinidae				
		Bank Swallow	*Riparia riparia*	Insectivore	Freshwater
		Barn Swallow	*Hirundo rustica*	Insectivore	Freshwater
		Cliff Swallow	*Petrochelidon pyrrhonota*	Insectivore	Freshwater
		Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	Insectivore	Freshwater
		Purple Martin	*Progne subis*	Insectivore	Freshwater
		Tree Swallow	*Tachycineta bicolor*	Insectivore	Freshwater
		Violet-green Swallow	*Tachycineta thalassina*	Insectivore	Freshwater
	Icteridae				
		Brewer's Blackbird	*Euphagus cyanocephalus*	Omnivore	Terrestrial-ground
		Brown-headed Cowbird	*Molothrus ater*	Omnivore	Terrestrial-ground
		Great-tailed Grackle	*Quiscalus mexicanus*	Omnivore	Terrestrial-ground
		Red-winged Blackbird	*Agelaius phoeniceus*	Omnivore	Freshwater
		Rusty Blackbird	*Euphagus carolinus*	Omnivore	Freshwater
		Western Meadowlark	*Sturnella neglecta*	Insectivore	Terrestrial-ground
		Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	Omnivore	Freshwater
		Loggerhead Shrike	*Lanius ludovicianus*	Insectivore	Terrestrial-ground
	Mimidae				
		Gray Catbird	*Dumetella carolinensis*	Omnivore	Terrestrial-lower canopy

Table S1. *Species names continued*.

Order	Family	Common name	Species	Foraging guild	Habitat
	Paridae				
		Black-capped Chickadee	*Poecile atricapillus*	Insectivore	Terrestrial-lower canopy
		Mountain Chickadee	*Poecile gambeli*	Insectivore	Terrestrial-lower canopy
		Oak Titmouse	*Baeolophus inornatus*	Insectivore	Terrestrial-lower canopy
	Parulidae				
		Black-throated Gray Warbler	*Setophaga nigrescens*	Insectivore	Terrestrial-lower canopy
		Common Yellowthroat	*Geothlypis trichas*	Insectivore	Terrestrial-lower canopy
		Macgillivray's Warbler	*Geothlypis tolmiei*	Insectivore	Terrestrial-lower canopy
		Northern Waterthrush	*Parkesia noveboracensis*	Insectivore	Freshwater
		Orange-crowned Warbler	*Oreothlypis celata*	Insectivore	Terrestrial-lower canopy
		Wilson's Warbler	*Cardellina pusilla*	Insectivore	Terrestrial-lower canopy
		Yellow Warbler	*Setophaga petechia*	Insectivore	Terrestrial-lower canopy
		Yellow-breasted Chat	*Icteria virens*	Omnivore	Freshwater
		Yellow-rumped Warbler	*Setophaga coronata*	Insectivore	Terrestrial-lower canopy
	Passeridae				
		House Sparrow	*Passer domesticus*	Granivore	Terrestrial-ground
	Polioptilidae				
		Blue-gray Gnatcatcher	*Polioptila caerulea*	Insectivore	Terrestrial-upper canopy
	Regulidae				
		Ruby-crowned Kinglet	*Regulus calendula*	Insectivore	Terrestrial-lower canopy
	Sittidae				
		Red-breasted Nuthatch	*Sitta canadensis*	Insectivore	Terrestrial-upper canopy
	Sturnidae				
		European Starling	*Sturnus vulgaris*	Omnivore	Terrestrial-ground
	Troglodytidae				
		Bewick's Wren	*Thryomanes bewickii*	Insectivore	Terrestrial-ground
		Cactus Wren	*Campylorhynchus brunneicapillus*	Omnivore	Terrestrial-lower canopy
		House Wren	*Troglodytes aedon*	Insectivore	Terrestrial-lower canopy
		Marsh Wren	*Cistothorus palustris*	Insectivore	Fresh and brackish water
	Turdidae				
		American Robin	*Turdus migratorius*	Vermivore	Terrestrial-ground
		Gray-cheeked Thrush	*Catharus minimus*	Omnivore	Terrestrial-ground
		Mountain Bluebird	*Sialia currucoides*	Insectivore	Terrestrial-ground
		Varied Thrush	*Ixoreus naevius*	Insectivore	Terrestrial-ground
		Western Bluebird	*Sialia mexicana*	Insectivore	Terrestrial-ground
	Tyrannidae				
		Ash-throated Flycatcher	*Myiarchus cinerascens*	Insectivore	Terrestrial-lower canopy
		Black Phoebe	*Sayornis nigricans*	Insectivore	Freshwater
		Dusky Flycatcher	*Empidonax oberholseri*	Insectivore	Terrestrial-lower canopy
		Olive-sided Flycatcher	*Contopus cooperi*	Insectivore	Terrestrial-lower canopy

Table S1. *Species names continued.*

Order	Family	Common name	Species	Foraging guild	Habitat
		Vermilion Flycatcher	*Pyrocephalus rubinus*	Insectivore	Terrestrial-lower canopy
		Western Kingbird	*Tyrannus verticalis*	Insectivore	Terrestrial-lower canopy
		Willow Flycatcher	*Empidonax traillii*	Insectivore	Freshwater
		Yellow-bellied Flycatcher	*Empidonax flaviventris*	Insectivore	Terrestrial-lower canopy
	Vireonidae				
		Bell's Vireo	*Vireo bellii*	Insectivore	Terrestrial-lower canopy
		Warbling Vireo	*Vireo gilvus*	Insectivore	Terrestrial-upper canopy
Pelecaniformes					
	Ardeidae				
		American Bittern	*Botaurus lentiginosus*	Carnivore	Freshwater
		Black-crowned Night-heron	*Nycticorax nycticorax*	Piscivore	Freshwater
		Cattle Egret	*Bubulcus ibis*	Insectivore	Freshwater
		Great Blue Heron	*Ardea herodias*	Piscivore	Freshwater
		Great Egret	*Ardea alba*	Piscivore	Freshwater
		Least Bittern	*Ixobrychus exilis*	Piscivore	Freshwater
		Little Blue Heron	*Egretta caerulea*	Crustaceovore	Freshwater
		Reddish Egret	*Egretta rufescens*	Piscivore	Coastal
		Snowy Egret	*Egretta thula*	Piscivore	Freshwater
		Tricolored Heron	*Egretta tricolor*	Piscivore	Coastal
	Pelecanidae				
		American White Pelican	*Pelecanus erythrorhynchos*	Piscivore	Freshwater
		Brown Pelican	*Pelecanus occidentalis*	Piscivore	Coastal
	Threskiornithidae				
		Roseate Spoonbill	*Platalea ajaja*	Piscivore	Coastal
		White-faced Ibis	*Plegadis chihi*	Crustaceovore	Fresh and brackish water
Phaethontiformes					
	Phaethontidae				
		Red-tailed Tropicbird	*Phaethon rubricauda*	Piscivore	Ocean
Piciformes					
	Picidae				
		Hairy Woodpecker	*Picoides villosus*	Insectivore	Terrestrial-upper canopy
		Northern Flicker	*Colaptes auratus*	Insectivore	Terrestrial-ground
		Red-naped Sapsucker	*Sphyrapicus nuchalis*	Omnivore	Terrestrial-upper canopy
Podicipediformes					
	Podicipedidae				
		Clark's Grebe	*Aechmophorus clarkii*	Piscivore	Freshwater
		Eared Grebe	*Podiceps nigricollis*	Insectivore	Fresh and brackish water
		Horned Grebe	*Podiceps auritus*	Insectivore	Freshwater
		Pied-billed Grebe	*Podilymbus podiceps*	Insectivore	Freshwater
		Red-necked Grebe	*Podiceps grisegena*	Piscivore	Freshwater
		Western Grebe	*Aechmophorus occidentalis*	Piscivore	Freshwater
Procellariiformes					
	Diomedeidae				
		Black-footed Albatross	*Phoebastria nigripes*	Piscivore	Ocean

Table S1. *Species names continued*.

Order	Family	Common name	Species	Foraging guild	Habitat
		Laysan Albatross	*Phoebastria immutabilis*	Piscivore	Ocean
	Hydrobatidae				
		Fork-tailed Storm-petrel	*Oceanodroma furcata*	Piscivore	Ocean
		Leach's Storm-petrel	*Oceanodroma leucorhoa*	Piscivore	Ocean
	Procellariidae				
		Bonin Petrel	*Pterodroma hypoleuca*	Piscivore	Ocean
		Buller's Shearwater	*Puffinus bulleri*	Crustaceovore	Ocean
		Christmas Shearwater	*Puffinus nativitatis*	Piscivore	Ocean
		Flesh-footed Shearwater	*Puffinus carneipes*	Piscivore	Ocean
		Northern Fulmar	*Fulmarus glacialis*	Piscivore	Ocean
		Short-tailed Shearwater	*Puffinus tenuirostris*	Crustaceovore	Ocean
		Sooty Shearwater	*Puffinus griseus*	Carnivore	Ocean
		Wedge-tailed Shearwater	*Puffinus pacificus*	Piscivore	Ocean
Strigiformes					
	Strigidae				
		Burrowing Owl	*Athene cunicularia*	Carnivore	Terrestrial-ground
		Ferruginous Pygmy-owl	*Glaucidium brasilianum*	Carnivore	Terrestrial-ground
		Great Horned Owl	*Bubo virginianus*	Carnivore	Terrestrial-ground
		Northern Saw-whet Owl	*Aegolius acadicus*	Carnivore	Terrestrial-ground
		Snowy Owl	*Bubo scandiacus*	Carnivore	Terrestrial-ground
	Tytonidae				
		Barn Owl	*Tyto alba*	Carnivore	Terrestrial-ground
Suliformes					
	Fregatidae				
		Great Frigatebird	*Fregata minor*	Piscivore	Ocean
	Phalacrocoracidae				
		Brandt's Cormorant	*Phalacrocorax penicillatus*	Piscivore	Coastal
		Double-crested Cormorant	*Phalacrocorax auritus*	Piscivore	Fresh and brackish water
		Neotropic Cormorant	*Phalacrocorax brasilianus*	Piscivore	Coastal
		Pelagic Cormorant	*Phalacrocorax pelagicus*	Piscivore	Coastal
	Sulidae				
		Brown Booby	*Sula leucogaster*	Piscivore	Coastal
		Red-footed Booby	*Sula sula*	Piscivore	Coastal

Table S2. Total mercury concentrations (µg/g ww) in bird eggs in western North America. Data represent the sample size (*n*), geometric mean (mean), standard error (SE), median, and the fifth and ninety-fifth percentile of the original raw data (*n*=20,335 eggs). Species are organized by order, family, and then alphabetically.

Order	Family	Common name	*n*	Mean	SE	Median	5th percentile	95th percentile
Accipitriformes								
	Accipitridae							
		Bald Eagle	219	0.27	0.01	0.28	0.12	0.62
		Cooper's Hawk	6	0.02	0.00	0.02	0.02	0.02
		Golden Eagle	1	0.05	---	0.05	---	---
		Hawaiian Hawk	5	0.03	0.00	0.03	0.02	0.03
		Northern Goshawk	3	0.07	0.01	0.06	0.06	0.08
		Northern Harrier	1	0.14	---	0.14	---	---
	Pandionidae							
		Osprey	232	0.07	0.00	0.07	0.02	0.07
Anseriformes								
	Anatidae							
		Blue-winged Teal	46	0.07	0.01	0.08	0.03	0.18
		Canada Goose	159	0.01	0.00	0.01	0.00	0.04
		Cinnamon Teal	56	0.13	0.01	0.13	0.06	0.25
		Common Goldeneye	2	0.18	0.02	0.18	0.17	0.20
		Gadwall	71	0.07	0.01	0.08	0.02	0.28
		Lesser Scaup	28	0.05	0.01	0.05	0.03	0.14
		Mallard	237	0.06	0.00	0.06	0.01	0.26
		Northern Pintail	10	0.09	0.02	0.11	0.03	0.22
		Northern Shoveler	28	0.16	0.03	0.16	0.04	0.60
		Redhead	45	0.08	0.01	0.09	0.02	0.24
		Ruddy Duck	29	0.01	0.00	0.01	0.01	0.06
		Snow Goose	30	0.02	0.00	0.01	0.01	0.06
		Spectacled Eider	21	0.05	0.00	0.05	0.03	0.11
		Trumpeter Swan	2	0.01	0.00	0.01	0.01	0.01
		White-winged Scoter	6	0.06	0.01	0.06	0.05	0.11
		Wood Duck	87	0.07	0.01	0.10	0.00	0.73
Charadriiformes								
	Alcidae							
		Cassin's Auklet	22	0.12	0.01	0.12	0.07	0.22
		Common Murre	198	0.09	0.01	0.12	0.02	0.27
		Kittlitz's Murrelet	1	0.01	---	0.01	---	---
		Marbled Murrelet	2	0.21	0.05	0.22	0.18	0.26
		Pigeon Guillemot	26	0.95	0.08	0.93	0.50	1.63
		Rhinoceros Auklet	21	0.45	0.04	0.44	0.23	0.90

Table S2. *Egg THg (μg/g ww) continued.*

Order	Family	Common name	*n*	Mean	SE	Median	5th percentile	95th percentile
		Thick-billed Murre	141	0.07	0.01	0.07	0.01	0.27
	Charadriidae							
		Killdeer	123	0.08	0.01	0.09	0.02	0.26
		Mountain Plover	75	0.04	0.00	0.03	0.01	0.12
		Piping Plover	178	0.10	0.01	0.09	0.04	0.39
		Snowy Plover	132	0.33	0.02	0.35	0.08	1.53
	Haematopodidae							
		American Oystercatcher	20	0.17	0.03	0.20	0.05	0.45
	Laridae							
		Black Skimmer	68	0.42	0.05	0.50	0.12	1.83
		Black Tern	5	0.12	0.03	0.12	0.06	0.18
		California Gull	563	0.08	0.00	0.08	0.03	0.23
		Caspian Tern	85	0.75	0.03	0.74	0.40	1.55
		Elegant Tern	5	0.38	0.02	0.39	0.34	0.44
		Forster's Tern	4460	1.06	0.01	1.06	0.45	2.64
		Franklin's Gull	163	0.09	0.00	0.08	0.04	0.20
		Glaucous Gull	61	0.14	0.01	0.15	0.07	0.26
		Glaucous-winged Gull	17	0.12	0.01	0.12	0.08	0.23
		Gull-billed Tern	1	0.41	---	0.41	---	---
		Laughing Gull	10	0.13	0.03	0.13	0.05	0.34
		Least Tern	618	0.53	0.02	0.50	0.18	2.08
		Little Tern	7	0.35	0.07	0.36	0.18	0.70
		Mew Gull	2	0.07	0.02	0.07	0.05	0.08
		Ring-billed Gull	63	0.06	0.00	0.06	0.03	0.16
		Royal Tern	10	0.78	0.09	0.85	0.42	1.14
		Sooty Tern	10	0.09	0.02	0.12	0.04	0.18
		Western Gull	6	0.54	0.11	0.57	0.29	0.89
	Recurvirostridae							
		American Avocet	3922	0.18	0.00	0.17	0.04	0.83
		Black-necked Stilt	1518	0.37	0.01	0.36	0.09	1.59
	Scolopacidae							
		Common Snipe	4	0.05	0.01	0.06	0.04	0.08
		Wilson's Phalarope	5	0.46	0.18	0.46	0.19	1.25
Columbiformes								
	Columbidae							
		Mourning Dove	5	0.01	0.01	0.01	0.01	0.01

Table S2. *Egg THg (µg/g ww) continued.*

Order	Family	Common name	*n*	Mean	SE	Median	5th percentile	95th percentile
Falconiformes								
	Falconidae							
		American Kestrel	2	0.02	0.01	0.02	0.01	0.03
		Aplomado Falcon	30	0.16	0.02	0.18	0.04	0.46
		Peregrine Falcon	50	0.45	0.04	0.43	0.21	1.52
Galliformes								
	Phasianidae							
		Ring-necked Pheasant	5	0.00	0.00	0.00	0.00	0.01
Gaviiformes								
	Gaviidae							
		Common Loon	72	0.34	0.03	0.38	0.09	1.06
		Pacific Loon	2	0.11	0.03	0.11	0.09	0.14
		Red-throated Loon	45	0.20	0.01	0.19	0.11	0.40
		Yellow-billed Loon	11	0.40	0.07	0.31	0.23	1.13
Gruiformes								
	Rallidae							
		American Coot	580	0.11	0.01	0.09	0.02	0.94
		Clapper Rail	89	0.52	0.06	0.57	0.03	2.08
		Common Gallinule	1	0.03	---	0.03	---	---
		Sora	3	0.09	0.01	0.09	0.08	0.11
		Virginia Rail	3	0.77	0.05	0.74	0.70	0.86
Passeriformes								
	Alaudidae							
		Horned Lark	11	0.01	0.00	0.01	0.01	0.03
	Cardinalidae							
		Summer Tanager	1	0.05	---	0.05	---	---
	Corvidae							
		American Crow	1	0.02	---	0.02	---	---
	Emberizidae							
		Song Sparrow	3	0.09	0.01	0.10	0.08	0.11
		Spotted Towhee	1	0.04	---	0.04	---	---
	Fringillidae							
		House Finch	1	0.02	---	0.02	---	---
	Hirundinidae							
		Bank Swallow	4	0.14	0.07	0.13	0.06	0.49
		Barn Swallow	76	0.11	0.01	0.11	0.04	0.37
		Cliff Swallow	325	0.06	0.00	0.07	0.02	0.16
		Purple Martin	57	0.05	0.00	0.04	0.03	0.08

Table S2. *Egg THg (µg/g ww) continued.*

Order	Family	Common name	*n*	Mean	SE	Median	5th percentile	95th percentile
		Tree Swallow	1302	0.12	0.00	0.13	0.03	0.39
	Icteridae							
		Brown-headed Cowbird	17	0.05	0.01	0.06	0.00	0.20
		Great-tailed Grackle	27	0.01	0.00	0.01	0.01	0.09
		Red-winged Blackbird	66	0.02	0.00	0.02	0.00	0.09
		Western Meadowlark	2	0.01	0.00	0.01	0.01	0.01
		Yellow-headed Blackbird	150	0.03	0.00	0.03	0.00	0.08
	Laniidae							
		Loggerhead Shrike	1	0.02	---	0.02	---	---
	Paridae							
		Mountain Chickadee	3	0.14	0.02	0.14	0.12	0.18
		Oak Titmouse	1	0.07	---	0.07	---	---
	Parulidae							
		Black-throated Gray Warbler	1	0.20	---	0.20	---	---
		Common Yellowthroat	2	0.08	0.02	0.08	0.06	0.10
		Yellow-breasted Chat	21	0.08	0.02	0.07	0.03	0.79
	Passeridae							
		House Sparrow	7	0.01	0.00	0.01	0.00	0.02
	Sturnidae							
		European Starling	5	0.02	0.00	0.02	0.01	0.03
	Troglodytidae							
		Bewick's Wren	3	0.09	0.03	0.09	0.06	0.15
		House Wren	692	0.10	0.00	0.11	0.03	0.23
		Marsh Wren	312	0.07	0.00	0.07	0.04	0.13
	Turdidae							
		Western Bluebird	41	0.06	0.01	0.07	0.02	0.15
	Tyrannidae							
		Ash-throated Flycatcher	82	0.10	0.01	0.09	0.02	0.38
		Black Phoebe	2	0.09	0.06	0.10	0.05	0.16
		Vermilion Flycatcher	2	0.36	0.07	0.36	0.30	0.43
		Western Kingbird	5	0.10	0.09	0.03	0.02	1.00
		Willow Flycatcher	45	0.06	0.01	0.06	0.02	0.37
	Vireonidae							
		Bell's Vireo	5	0.39	0.02	0.39	0.33	0.44
Pelecaniformes								
	Ardeidae							
		Black-crowned Night-heron	231	0.14	0.01	0.15	0.04	0.53

Table S2. *Egg THg (µg/g ww) continued.*

Order	Family	Common name	*n*	Mean	SE	Median	5th percentile	95th percentile
		Cattle Egret	1	0.11	---	0.11	---	---
		Great Blue Heron	269	0.10	0.00	0.10	0.04	0.31
		Great Egret	4	0.19	0.05	0.16	0.14	0.36
		Least Bittern	3	0.07	0.01	0.08	0.05	0.09
		Little Blue Heron	10	0.10	0.03	0.07	0.05	0.41
		Reddish Egret	30	0.08	0.01	0.08	0.05	0.14
		Snowy Egret	73	0.15	0.02	0.17	0.03	0.71
		Tricolored Heron	119	0.10	0.01	0.11	0.04	0.20
	Pelecanidae							
		American White Pelican	74	0.21	0.02	0.23	0.04	0.79
		Brown Pelican	101	0.20	0.01	0.18	0.10	0.48
	Threskiornithidae							
		Roseate Spoonbill	9	0.23	0.03	0.23	0.14	0.39
		White-faced Ibis	361	0.06	0.00	0.06	0.03	0.19
Podicipediformes								
	Podicipedidae							
		Clark's Grebe	19	0.10	0.01	0.10	0.05	0.19
		Eared Grebe	206	0.08	0.00	0.08	0.03	0.20
		Pied-billed Grebe	44	0.18	0.01	0.18	0.10	0.37
		Red-necked Grebe	16	0.11	0.01	0.11	0.08	0.17
		Western Grebe	224	0.08	0.00	0.07	0.04	0.18
Procellariiformes								
	Diomedeidae							
		Black-footed Albatross	16	1.19	0.13	1.18	0.65	2.25
		Laysan Albatross	204	0.31	0.01	0.31	0.16	0.63
	Hydrobatidae							
		Fork-tailed Storm-petrel	3	0.63	0.14	0.59	0.46	0.92
		Leach's Storm-petrel	6	0.66	0.09	0.69	0.43	0.90
Strigiformes								
	Strigidae							
		Ferruginous Pygmy-owl	5	0.03	0.01	0.02	0.02	0.06
	Tytonidae							
		Barn Owl	1	0.01	---	0.01	---	---
Suliformes								
	Phalacrocoracidae							
		Double-crested Cormorant	249	0.25	0.01	0.26	0.06	0.99
	Sulidae							
		Brown Booby	19	0.14	0.01	0.13	0.08	0.26

Table S3. Total mercury concentrations (μg/g ww) in bird blood in western North America. Data represent the sample size (*n*), geometric mean (mean), standard error (SE), median, and the fifth and ninety-fifth percentile of the original raw data (*n*=4,639). Species are organized by order, family, and then alphabetically.

Order	Family	Common name	*n*	Mean	SE	Median	5th percentile	95th percentile
Accipitriformes								
	Accipitridae							
		Bald Eagle	107	0.96	0.06	1.00	0.34	2.33
		Golden Eagle	1	0.01	---	0.01	---	---
Anseriformes								
	Anatidae							
		American Wigeon	1	2.13	---	2.13	---	---
		Barrow's Goldeneye	64	0.25	0.01	0.24	0.18	0.44
		Black Scoter	3	0.26	0.08	0.28	0.17	0.41
		Brant	30	0.01	0.00	0.01	0.00	0.02
		Common Merganser	2	0.39	0.42	0.63	0.19	1.08
		Harlequin Duck	238	0.18	0.01	0.21	0.02	0.96
		Lesser Scaup	15	0.09	0.01	0.09	0.05	0.20
		Redhead	1	0.12	---	0.12	---	---
		Spectacled Eider	155	0.10	0.00	0.10	0.06	0.19
		Steller's Eider	30	0.08	0.00	0.08	0.05	0.12
		Surf Scoter	16	0.10	0.02	0.13	0.04	0.17
		White-winged Scoter	15	0.11	0.01	0.12	0.07	0.16
Charadriiformes								
	Alcidae							
		Kittlitz's Murrelet	17	0.18	0.02	0.18	0.09	0.41
		Marbled Murrelet	39	0.20	0.01	0.21	0.10	0.38
	Charadriidae							
		American Golden-plover	46	0.16	0.01	0.17	0.08	0.34
	Laridae							
		California Gull	122	0.17	0.01	0.16	0.05	0.64
		Caspian Tern	45	1.72	0.20	1.68	0.51	6.97
		Forster's Tern	108	1.62	0.15	1.67	0.33	7.41
	Recurvirostridae							
		American Avocet	102	0.30	0.03	0.28	0.06	1.80
		Black-necked Stilt	103	0.99	0.08	1.00	0.28	3.87
	Scolopacidae							
		Baird's Sandpiper	1	0.51	---	0.51	---	---
		Bar-tailed Godwit	3	0.34	0.13	0.39	0.19	0.57
		Black Turnstone	21	0.18	0.02	0.15	0.12	0.30
		Dunlin	261	0.18	0.01	0.19	0.06	0.45
		Hudsonian Godwit	3	0.22	0.07	0.17	0.15	0.39
		Long-billed Dowitcher	51	0.57	0.04	0.64	0.18	1.22
		Pectoral Sandpiper	73	0.47	0.03	0.44	0.20	1.06
		Red Phalarope	144	0.28	0.02	0.31	0.06	1.10
		Red-necked Phalarope	122	0.19	0.01	0.19	0.06	0.53
		Rock Sandpiper	26	0.09	0.01	0.07	0.04	0.33
		Ruddy Turnstone	14	0.34	0.08	0.23	0.15	1.92

Table S3. *Blood THg (µg/g ww) continued*.

Order	Family	Common name	*n*	Mean	SE	Median	5th percentile	95th percentile
		Semipalmated Sandpiper	282	0.22	0.01	0.19	0.06	1.06
		Western Sandpiper	93	0.22	0.01	0.22	0.08	0.50
		Whimbrel	3	0.28	0.16	0.26	0.12	0.74
Gaviiformes								
	Gaviidae							
		Common Loon	608	0.91	0.03	0.89	0.26	4.00
		Pacific Loon	63	0.45	0.06	0.44	0.09	2.32
		Red-throated Loon	67	0.47	0.06	0.48	0.05	2.25
		Yellow-billed Loon	165	0.63	0.04	0.60	0.20	2.36
Gruiformes								
	Rallidae							
		Clapper Rail	23	0.13	0.02	0.13	0.03	0.31
Passeriformes								
	Cardinalidae							
		Blue Grosbeak	1	0.01	---	0.01	---	---
		Lazuli Bunting	9	0.01	0.00	0.01	0.00	0.05
		Western Tanager	1	0.08	---	0.08	---	---
	Cinclidae							
		American Dipper	44	0.09	0.01	0.08	0.02	0.29
	Emberizidae							
		Brewer's Sparrow	2	0.12	0.02	0.12	0.11	0.14
		Dark-eyed Junco	6	0.09	0.02	0.10	0.05	0.15
		Green-tailed Towhee	1	0.08	---	0.08	---	---
		Lincoln's Sparrow	20	0.06	0.01	0.04	0.01	0.22
		Savannah Sparrow	2	0.06	0.01	0.07	0.06	0.07
		Song Sparrow	15	0.16	0.03	0.16	0.07	0.50
		Spotted Towhee	1	0.04	---	0.04	---	---
		Vesper Sparrow	1	0.22	---	0.22	---	---
		White-crowned Sparrow	44	0.02	0.01	0.02	0.00	0.36
	Fringillidae							
		American Goldfinch	1	0.54	---	0.54	---	---
		Black Rosy-finch	9	0.19	0.03	0.18	0.13	0.40
		Gray-crowned Rosy-finch	6	0.17	0.01	0.19	0.13	0.19
		Pine Siskin	14	0.34	0.05	0.29	0.20	0.75
	Hirundinidae							
		Bank Swallow	1	0.17	---	0.17	---	---
		Cliff Swallow	8	0.10	0.01	0.09	0.07	0.16
		Northern Rough-winged Swallow	2	0.05	0.01	0.05	0.04	0.06
		Tree Swallow	9	0.11	0.01	0.09	0.07	0.18
		Violet-green Swallow	1	0.11	---	0.11	---	---
	Icteridae							
		Brewer's Blackbird	1	0.19	---	0.19	---	---
		Brown-headed Cowbird	1	0.11	---	0.11	---	---
		Red-winged Blackbird	13	0.05	0.01	0.03	0.02	0.29
		Rusty Blackbird	187	0.14	0.01	0.15	0.02	0.74

Table S3. *Blood THg (µg/g ww) continued*.

Order	Family	Common name	*n*	Mean	SE	Median	5th percentile	95th percentile
		Western Meadowlark	1	0.02	---	0.02	---	---
	Mimidae							
		Gray Catbird	1	0.17	---	0.17	---	---
	Paridae							
		Black-capped Chickadee	11	0.23	0.04	0.23	0.11	0.45
		Mountain Chickadee	23	0.40	0.05	0.37	0.14	0.98
	Parulidae							
		Common Yellowthroat	8	0.12	0.02	0.13	0.06	0.23
		Macgillivray's Warbler	1	0.02	---	0.02	---	---
		Northern Waterthrush	26	0.15	0.02	0.14	0.08	0.40
		Orange-crowned Warbler	6	0.19	0.07	0.16	0.09	0.67
		Wilson's Warbler	7	0.21	0.03	0.22	0.13	0.30
		Yellow Warbler	23	0.12	0.02	0.12	0.05	0.31
		Yellow-breasted Chat	9	0.03	0.00	0.03	0.02	0.06
		Yellow-rumped Warbler	2	0.30	0.03	0.30	0.27	0.32
	Polioptilidae							
		Blue-gray Gnatcatcher	2	0.08	0.01	0.08	0.07	0.09
	Regulidae							
		Ruby-crowned Kinglet	9	0.18	0.05	0.16	0.07	0.49
	Sittidae							
		Red-breasted Nuthatch	2	0.45	0.11	0.47	0.37	0.57
	Troglodytidae							
		Cactus Wren	2	0.17	0.02	0.17	0.15	0.19
		House Wren	1	0.49	---	0.49	---	---
		Marsh Wren	45	0.42	0.03	0.44	0.27	0.76
	Turdidae							
		American Robin	5	0.41	0.15	0.34	0.18	1.27
		Gray-cheeked Thrush	21	0.03	0.00	0.03	0.02	0.07
		Mountain Bluebird	11	0.11	0.02	0.09	0.06	0.32
		Varied Thrush	16	0.02	0.01	0.02	0.01	0.17
	Tyrannidae							
		Ash-throated Flycatcher	1	0.06	---	0.06	---	---
		Dusky Flycatcher	4	0.62	0.11	0.69	0.42	0.84
		Olive-sided Flycatcher	3	0.18	0.04	0.21	0.12	0.24
		Willow Flycatcher	7	0.14	0.01	0.14	0.11	0.17
		Yellow-bellied Flycatcher	2	0.06	0.00	0.06	0.06	0.06
	Vireonidae							
		Warbling Vireo	11	0.09	0.01	0.09	0.05	0.20
Pelecaniformes								
	Ardeidae							
		Great Blue Heron	1	0.79	---	0.79	---	---
Piciformes								
	Picidae							
		Hairy Woodpecker	1	0.17	---	0.17	---	---
		Northern Flicker	1	1.27	---	1.27	---	---

Table S3. *Blood THg (µg/g ww) continued.*

Order	Family	Common name	*n*	Mean	SE	Median	5th percentile	95th percentile
		Red-naped Sapsucker	3	0.06	0.03	0.06	0.03	0.11
Podicipediformes								
	Podicipedidae							
		Clark's Grebe	208	0.96	0.07	0.95	0.19	6.75
		Eared Grebe	46	0.48	0.04	0.49	0.21	1.06
		Horned Grebe	2	4.75	1.89	5.13	3.39	6.88
		Pied-billed Grebe	4	0.56	0.11	0.63	0.36	0.75
		Red-necked Grebe	12	0.48	0.13	0.38	0.15	1.91
		Western Grebe	415	0.61	0.03	0.62	0.14	3.00
Strigiformes								
	Strigidae							
		Northern Saw-whet Owl	3	0.90	0.14	1.03	0.69	1.07

Table S4. Total mercury concentrations (μg/g dw) in bird muscle in western North America. Data represent the sample size (*n*), geometric mean (mean), standard error (SE), median, and the fifth and ninety-fifth percentile of the original raw data (*n*=517). Species are organized by order, family, and then alphabetically.

Order	Family	Common name	*n*	Mean	SE	Median	5th percentile	95th percentile
Anseriformes								
	Anatidae							
		Green-winged Teal	45	0.63	0.10	0.58	0.13	2.82
		Mallard	19	0.09	0.02	0.05	0.03	0.41
		Northern Shoveler	29	4.15	0.67	4.20	1.18	11.60
		Steller's Eider	2	0.58	0.21	0.62	0.43	0.81
Charadriiformes								
	Laridae							
		Caspian Tern	49	2.91	0.27	3.14	0.85	7.61
		Forster's Tern	115	2.99	0.24	2.91	0.73	12.99
	Recurvirostridae							
		American Avocet	127	1.00	0.09	0.88	0.25	5.14
		Black-necked Stilt	113	2.61	0.18	2.65	0.87	8.87
Gruiformes								
	Gruidae							
		Sandhill Crane	7	0.13	0.00	0.13	0.12	0.13
		Whooping Crane	2	0.22	0.12	0.25	0.14	0.36
	Rallidae							
		American Coot	1	0.09	---	0.09	---	---
		Clapper Rail	1	1.19	---	1.19	---	---
Pelecaniformes								
	Ardeidae							
		Great Blue Heron	4	1.61	0.41	1.65	1.02	2.71
	Pelecanidae							
		American White Pelican	2	1.30	0.10	1.30	1.21	1.39
Suliformes								
	Phalacrocoracidae							
		Double-crested Cormorant	1	1.30	---	1.30	---	---

Table S5. Total mercury concentrations (µg/g dw) in bird livers in western North America. Data represent the sample size (*n*), geometric mean (mean), standard error (SE), median, and the fifth and ninety-fifth percentile of the original raw data (*n*=2,036). Species are organized by order, family, and then alphabetically.

Order	Family	Common name	*n*	Mean	SE	Median	5th percentile	95th percentile
Accipitriformes								
	Accipitridae							
		Bald Eagle	16	7.45	1.36	7.85	2.39	18.52
		Red-tailed Hawk	2	0.43	0.02	0.43	0.41	0.45
	Pandionidae							
		Osprey	1	12.95	---	12.95	---	---
Anseriformes								
	Anatidae							
		American Wigeon	1	0.11	---	0.11	---	---
		Black Scoter	2	2.84	0.34	2.86	2.55	3.17
		Blue-winged Teal	6	0.72	0.37	1.05	0.18	2.46
		Canvasback	33	2.53	0.30	2.88	0.73	6.10
		Cinnamon Teal	3	0.94	0.36	0.84	0.55	1.80
		Common Eider	50	1.78	0.12	1.70	0.97	4.22
		Common Goldeneye	1	5.91	---	5.91	---	---
		Emperor Goose	2	0.81	0.38	0.90	0.54	1.26
		Gadwall	10	0.82	0.18	0.61	0.46	2.72
		Greater Scaup	62	4.68	0.36	4.94	1.92	10.60
		Green-winged Teal	51	1.73	0.24	1.67	0.38	7.74
		Hooded Merganser	1	0.44	---	0.44	---	---
		King Eider	54	2.08	0.14	2.18	0.92	4.24
		Lesser Scaup	27	1.70	0.24	1.77	0.49	4.82
		Mallard	64	0.12	0.02	0.10	0.05	0.96
		Northern Pintail	2	0.43	0.06	0.43	0.38	0.49
		Northern Shoveler	48	7.71	1.53	8.88	0.94	49.17
		Red-breasted Merganser	5	8.04	2.47	8.86	4.02	19.77
		Redhead	1	0.38	---	0.38	---	---
		Ruddy Duck	6	1.03	0.46	0.81	0.33	4.83
		Snow Goose	34	0.10	0.00	0.10	0.10	0.10
		Spectacled Eider	30	1.25	0.12	1.16	0.62	2.66
		Steller's Eider	10	2.74	0.50	2.68	1.30	6.90
		Surf Scoter	100	1.47	0.10	1.40	0.49	4.35
		White-winged Scoter	50	1.28	0.13	1.20	0.47	4.50
		Wood Duck	26	0.12	0.01	0.10	0.10	0.22

Table S5. *Liver THg (µg/g dw) continued.*

Order	Family	Common name	*n*	Mean	SE	Median	5th percentile	95th percentile
Charadriiformes								
	Alcidae							
		Common Murre	31	3.00	0.40	3.89	0.80	7.86
		Crested Auklet	1	1.14	---	1.14	---	---
		Marbled Murrelet	7	1.44	0.46	1.24	0.54	3.82
		Parakeet Auklet	1	2.00	---	2.00	---	---
		Pigeon Guillemot	1	6.36	---	6.36	---	---
		Tufted Puffin	13	2.94	0.18	2.76	2.19	4.30
		Whiskered Auklet	1	1.40	---	1.40	---	---
	Charadriidae							
		Black-bellied Plover	13	0.81	0.11	0.78	0.41	1.53
		Killdeer	9	0.51	0.05	0.49	0.36	0.76
		Mountain Plover	25	0.16	0.02	0.12	0.10	0.59
	Haematopodidae							
		American Oystercatcher	20	2.49	0.42	2.71	0.97	7.52
	Laridae							
		Black Skimmer	1	6.13	---	6.13	---	---
		Black-legged Kittiwake	1	3.34	---	3.34	---	---
		California Gull	4	0.64	0.30	0.67	0.25	1.80
		Caspian Tern	56	7.82	0.77	9.12	2.29	19.15
		Elegant Tern	1	6.10	---	6.10	---	---
		Forster's Tern	114	9.10	0.77	9.60	2.15	35.74
		Franklin's Gull	1	1.61	---	1.61	---	---
		Glaucous-winged Gull	13	2.22	0.50	1.80	0.96	7.14
		Least Tern	1	2.43	---	2.43	---	---
	Recurvirostridae							
		American Avocet	176	2.11	0.18	1.88	0.42	16.56
		Black-necked Stilt	118	7.19	0.62	7.30	2.08	35.46
	Scolopacidae							
		Long-billed Curlew	2	0.03	0.00	0.03	0.03	0.03
		Long-billed Dowitcher	53	1.60	0.14	1.45	0.68	4.63
		Spotted Sandpiper	5	0.77	0.31	0.57	0.39	2.91
		Western Sandpiper	8	3.74	0.50	4.50	2.05	5.06
		Willet	61	5.65	1.06	3.90	0.98	57.35
		Wilson's Phalarope	7	3.54	1.04	3.40	1.52	11.97
Columbiformes								
	Columbidae							
		Mourning Dove	13	0.06	0.01	0.07	0.02	0.14

Table S5. *Liver THg (µg/g dw) continued.*

Order	Family	Common name	*n*	Mean	SE	Median	5th percentile	95th percentile
Falconiformes								
	Falconidae							
		Peregrine Falcon	1	0.31	---	0.31	---	---
Galliformes								
	Odontophoridae							
		Northern Bobwhite	1	0.10	---	0.10	---	---
	Phasianidae							
		Ring-necked Pheasant	5	0.02	0.01	0.04	0.01	0.05
		Rock Ptarmigan	12	0.18	0.03	0.18	0.08	0.48
		Wild Turkey	2	0.10	0.00	0.10	0.10	0.10
Gaviiformes								
	Gaviidae							
		Common Loon	2	76.94	51.88	95.10	44.79	145.41
Gruiformes								
	Gruidae							
		Sandhill Crane	25	0.07	0.01	0.10	0.01	0.13
		Whooping Crane	3	1.80	1.40	2.83	0.64	4.96
	Rallidae							
		American Coot	138	0.86	0.07	0.86	0.17	4.03
		Clapper Rail	9	11.65	4.66	15.00	2.38	46.60
Passeriformes								
	Cinclidae							
		American Dipper	2	0.24	0.01	0.24	0.23	0.25
	Emberizidae							
		Abert's Towhee	5	0.22	0.06	0.21	0.11	0.51
		Lincoln's Sparrow	1	0.42	---	0.42	---	---
		Savannah Sparrow	3	0.30	0.08	0.35	0.19	0.42
		Song Sparrow	2	0.15	0.06	0.16	0.11	0.22
		White-crowned Sparrow	4	0.11	0.04	0.09	0.06	0.30
	Hirundinidae							
		Barn Swallow	1	0.24	---	0.24	---	---
		Cliff Swallow	13	0.31	0.04	0.29	0.18	0.68
		Northern Rough-winged Swallow	2	0.32	0.04	0.32	0.29	0.36
		Tree Swallow	3	0.19	0.03	0.17	0.16	0.26
	Icteridae							
		Red-winged Blackbird	11	0.59	0.24	0.56	0.08	3.07
		Western Meadowlark	5	0.15	0.04	0.12	0.09	0.35
		Yellow-headed Blackbird	1	0.07	---	0.07	---	---

Table S5. *Liver THg (µg/g dw) continued.*

Order	Family	Common name	*n*	Mean	SE	Median	5th percentile	95th percentile
	Paridae							
		Black-capped Chickadee	20	0.05	0.01	0.04	0.02	0.12
	Troglodytidae							
		House Wren	5	0.13	0.01	0.12	0.11	0.16
	Turdidae							
		American Robin	4	0.22	0.15	0.13	0.10	1.38
		Western Bluebird	2	0.76	0.04	0.76	0.73	0.79
Pelecaniformes								
	Ardeidae							
		Black-crowned Night-heron	6	8.93	2.38	7.36	5.10	24.15
		Great Blue Heron	5	7.69	3.29	6.40	2.92	24.63
	Pelecanidae							
		American White Pelican	24	21.27	5.33	17.95	4.31	141.47
		Brown Pelican	25	1.09	0.35	0.94	0.16	20.95
Podicipediformes								
	Podicipedidae							
		Eared Grebe	163	5.78	0.40	6.77	0.82	17.06
Procellariiformes								
	Procellariidae							
		Northern Fulmar	13	14.10	2.34	15.50	5.76	32.04
Strigiformes								
	Strigidae							
		Great Horned Owl	2	1.32	0.36	1.37	1.04	1.69
Suliformes								
	Phalacrocoracidae							
		Double-crested Cormorant	60	12.43	1.42	9.49	4.30	68.18
		Pelagic Cormorant	1	15.30	---	15.30	---	---

Table S6. Total mercury concentrations (µg/g dw) in bird kidneys in western North America. Data represent the sample size (*n*), geometric mean (mean), standard error (SE), median, and the fifth and ninety-fifth percentile of the original raw data (*n*=770). Species are organized by order, family, and then alphabetically.

Order	Family	Common name	*n*	Mean	SE	Median	5th percentile	95th percentile
Accipitriformes								
	Accipitridae							
		Bald Eagle	16	24.30	4.29	22.23	7.72	71.95
		Red-tailed Hawk	2	0.56	0.00	0.56	0.56	0.57
Anseriformes								
	Anatidae							
		Black Scoter	2	1.30	0.10	1.30	1.21	1.39
		Canvasback	3	2.43	0.29	2.68	1.99	2.78
		Common Eider	50	0.90	0.06	0.83	0.49	2.43
		Emperor Goose	2	0.40	0.39	0.61	0.20	1.02
		Gadwall	1	0.08	---	0.08	---	---
		Greater Scaup	2	1.29	0.26	1.32	1.08	1.55
		King Eider	54	1.16	0.08	1.31	0.54	2.12
		Lesser Scaup	1	0.49	---	0.49	---	---
		Mallard	2	0.16	0.24	0.38	0.07	0.69
		Northern Pintail	1	0.26	---	0.26	---	---
		Northern Shoveler	4	1.46	0.75	1.86	0.51	3.91
		Ruddy Duck	3	0.94	0.60	0.64	0.42	3.03
		Spectacled Eider	30	0.64	0.07	0.71	0.18	1.18
		Steller's Eider	7	1.23	0.29	1.15	0.54	2.49
		Surf Scoter	87	0.86	0.07	0.88	0.21	2.58
		White-winged Scoter	47	0.77	0.06	0.71	0.32	1.67
Charadriiformes								
	Alcidae							
		Common Murre	10	1.35	0.22	1.26	0.70	2.85
		Marbled Murrelet	9	1.28	0.39	1.02	0.54	5.61
	Charadriidae							
		Killdeer	4	0.52	0.12	0.63	0.32	0.69
	Laridae							
		Caspian Tern	50	8.89	0.88	9.67	2.60	25.27
		Forster's Tern	99	11.02	0.90	11.25	3.26	40.67
	Recurvirostridae							
		American Avocet	127	2.65	0.23	2.33	0.65	14.14
		Black-necked Stilt	115	6.69	0.51	6.78	2.11	23.13
Columbiformes								
	Columbidae							
		Mourning Dove	3	0.01	0.01	0.02	0.01	0.02
Falconiformes								
	Falconidae							
		Peregrine Falcon	1	0.72	---	0.72	---	---

Table S6. *Kidney THg (µg/g dw) continued*.

Order	Family	Common name	*n*	Mean	SE	Median	5th percentile	95th percentile
Gruiformes								
	Gruidae							
		Sandhill Crane	7	0.13	0.00	0.13	0.12	0.13
		Whooping Crane	3	1.03	0.79	1.22	0.35	3.30
	Rallidae							
		American Coot	10	0.63	0.09	0.58	0.38	1.32
		Clapper Rail	6	5.54	1.45	6.40	2.53	10.70
Passeriformes								
	Cinclidae							
		American Dipper	2	1.89	0.36	1.92	1.60	2.25
	Emberizidae							
		Lincoln's Sparrow	1	0.69	---	0.69	---	---
		Savannah Sparrow	2	0.71	0.06	0.71	0.65	0.77
		White-crowned Sparrow	3	0.17	0.03	0.19	0.13	0.22
	Icteridae							
		Red-winged Blackbird	2	4.12	0.00	4.12	4.12	4.12
	Turdidae							
		American Robin	1	2.22	---	2.22	---	---
Podicipediformes								
	Podicipedidae							
		Eared Grebe	1	5.78	---	5.78	---	---

Table S7. Total mercury concentrations (μg/g dw) in bird feathers in western North America. Data represent the sample size (*n*), geometric mean (mean), standard error (SE), median, and the fifth and ninety-fifth percentile of the original raw data (*n*=922). Species are organized by order, family, and then alphabetically.

Order	Family	Common name	*n*	Mean	SE	Median	5th percentile	95th percentile
Accipitriformes								
	Accipitridae							
		Bald Eagle	7	20.27	3.78	25.20	10.38	31.98
	Pandionidae							
		Osprey	8	7.89	1.94	7.02	3.69	17.74
Anseriformes								
	Anatidae							
		Common Eider	2	0.15	0.09	0.18	0.09	0.26
		King Eider	35	1.05	0.06	1.00	0.60	1.66
		Northern Pintail	1	0.28	---	0.28	---	---
		Spectacled Eider	12	0.12	0.03	0.13	0.03	0.31
		Steller's Eider	4	0.16	0.04	0.15	0.10	0.26
		White-winged Scoter	1	1.23	---	1.23	---	---
Charadriiformes								
	Alcidae							
		Kittlitz's Murrelet	15	1.15	0.12	1.13	0.72	1.79
	Charadriidae							
		American Golden-plover	4	0.56	0.12	0.51	0.39	0.89
	Laridae							
		Caspian Tern	49	8.96	1.29	8.75	1.71	33.88
		Forster's Tern	181	9.76	0.67	10.38	2.53	31.65
	Recurvirostridae							
		American Avocet	126	2.43	0.17	2.38	0.63	6.19
		Black-necked Stilt	112	8.37	0.55	8.40	2.41	21.31
	Scolopacidae							
		Dunlin	19	1.51	0.21	1.42	0.57	2.88
		Pectoral Sandpiper	14	2.74	0.43	2.28	1.54	7.06
		Red Phalarope	37	0.57	0.05	0.47	0.27	1.04
		Red-necked Phalarope	19	0.48	0.06	0.44	0.25	1.06
		Semipalmated Sandpiper	135	0.71	0.04	0.69	0.19	1.72
		Western Sandpiper	54	1.08	0.14	1.03	0.25	4.30
Falconiformes								
	Falconidae							
		Peregrine Falcon	3	4.03	1.12	3.14	2.99	6.24
Gaviiformes								
	Gaviidae							
		Pacific Loon	3	1.72	0.12	1.80	1.53	1.88
		Yellow-billed Loon	1	5.54	---	5.54	---	---
Gruiformes								
	Gruidae							
		Sandhill Crane	6	0.24	0.07	0.23	0.11	0.52
	Rallidae							
		Clapper Rail	26	1.98	0.30	2.10	0.69	4.75

Table S7. *Feather THg (μg/g dw) continued.*

Order	Family	Common name	*n*	Mean	SE	Median	5th percentile	95th percentile
Passeriformes								
	Cinclidae							
		American Dipper	2	0.91	0.03	0.91	0.88	0.94
	Fringillidae							
		Pine Siskin	1	0.05	---	0.05	---	---
	Troglodytidae							
		Marsh Wren	45	2.65	0.35	2.22	1.03	9.06

Table S8. Bird blood-equivalent total mercury concentrations (µg/g ww) in western North America. Data represent the sample size (*n*), geometric mean (mean), standard error (SE), median, and the fifth and ninety-fifth percentile of the original raw data (*n*=27,629). Species are organized by order, family, and then alphabetically.

Order	Family	Common name	*n*	Mean	SE	Median	5th percentile	95th percentile
Accipitriformes								
	Accipitridae							
		Bald Eagle	365	0.74	0.03	0.73	0.25	2.41
		Cooper's Hawk	6	0.04	0.00	0.04	0.03	0.04
		Golden Eagle	2	0.04	0.03	0.05	0.02	0.09
		Hawaiian Hawk	5	0.05	0.00	0.04	0.04	0.05
		Northern Goshawk	3	0.12	0.01	0.11	0.11	0.15
		Northern Harrier	1	0.27	---	0.27	---	---
		Red-tailed Hawk	4	0.07	0.00	0.07	0.06	0.08
	Pandionidae							
		Osprey	241	0.13	0.01	0.13	0.04	0.59
Anseriformes								
	Anatidae							
		American Wigeon	2	0.19	0.45	1.07	0.12	2.03
		Barrow's Goldeneye	64	0.25	0.01	0.24	0.18	0.44
		Black Scoter	7	0.26	0.05	0.28	0.16	0.44
		Blue-winged Teal	52	0.13	0.01	0.14	0.05	0.35
		Brant	30	0.01	0.00	0.01	0.00	0.02
		Canada Goose	159	0.01	0.00	0.01	0.00	0.06
		Canvasback	36	0.35	0.04	0.39	0.11	0.84
		Cinnamon Teal	59	0.25	0.02	0.25	0.11	0.52
		Common Eider	102	0.17	0.01	0.17	0.07	0.50
		Common Goldeneye	3	0.47	0.13	0.40	0.33	0.77
		Common Merganser	2	0.39	0.42	0.63	0.19	1.08
		Emperor Goose	4	0.08	0.04	0.11	0.03	0.18
		Gadwall	82	0.13	0.01	0.15	0.03	0.57
		Greater Scaup	64	0.62	0.05	0.68	0.20	1.43
		Green-winged Teal	96	0.23	0.03	0.22	0.05	1.11
		Harlequin Duck	238	0.18	0.01	0.21	0.02	0.96
		Hooded Merganser	1	0.07	---	0.07	---	---
		King Eider	143	0.21	0.01	0.21	0.08	0.52
		Lesser Scaup	71	0.13	0.01	0.11	0.05	0.58
		Mallard	322	0.07	0.00	0.07	0.01	0.48
		Northern Pintail	14	0.12	0.03	0.08	0.04	0.42
		Northern Shoveler	109	0.82	0.10	0.92	0.12	5.83
		Red-breasted Merganser	5	1.10	0.33	1.21	0.56	2.62
		Redhead	47	0.14	0.02	0.15	0.04	0.48
		Ruddy Duck	38	0.04	0.01	0.05	0.01	0.34
		Snow Goose	64	0.02	0.00	0.02	0.02	0.09
		Spectacled Eider	248	0.10	0.00	0.10	0.04	0.22
		Steller's Eider	53	0.12	0.01	0.09	0.04	0.43
		Surf Scoter	203	0.15	0.01	0.16	0.05	0.53
		Trumpeter Swan	2	0.02	0.00	0.02	0.02	0.02

Table S8. *Blood-equivalent THg (µg/g ww) continued*.

Order	Family	Common name	*n*	Mean	SE	Median	5th percentile	95th percentile
		White-winged Scoter	119	0.13	0.01	0.13	0.06	0.40
		Wood Duck	113	0.09	0.02	0.04	0.01	1.54
Charadriiformes								
	Alcidae							
		Cassin's Auklet	22	0.24	0.02	0.23	0.13	0.45
		Common Murre	239	0.20	0.01	0.24	0.03	0.67
		Crested Auklet	1	0.16	---	0.16	---	---
		Kittlitz's Murrelet	33	0.18	0.02	0.19	0.09	0.39
		Marbled Murrelet	57	0.20	0.02	0.21	0.08	0.47
		Parakeet Auklet	1	0.28	---	0.28	---	---
		Pigeon Guillemot	27	2.08	0.19	1.99	0.90	3.80
		Rhinoceros Auklet	21	0.97	0.10	0.94	0.46	2.02
		Thick-billed Murre	141	0.12	0.01	0.12	0.02	0.56
		Tufted Puffin	13	0.41	0.02	0.39	0.31	0.60
		Whiskered Auklet	1	0.20	---	0.20	---	---
	Charadriidae							
		American Golden-plover	50	0.16	0.01	0.16	0.08	0.33
		Black-bellied Plover	13	0.12	0.02	0.11	0.06	0.22
		Killdeer	136	0.14	0.01	0.15	0.04	0.53
		Mountain Plover	100	0.05	0.01	0.05	0.01	0.20
		Piping Plover	178	0.19	0.01	0.17	0.06	0.82
		Snowy Plover	132	0.69	0.05	0.72	0.14	3.56
	Haematopodidae							
		American Oystercatcher	40	0.34	0.04	0.39	0.10	1.03
	Laridae							
		Black Skimmer	69	0.90	0.11	1.07	0.24	4.29
		Black Tern	5	0.22	0.05	0.24	0.12	0.36
		Black-legged Kittiwake	1	0.47	---	0.47	---	---
		California Gull	689	0.15	0.00	0.15	0.05	0.52
		Caspian Tern	141	1.58	0.08	1.60	0.53	4.48
		Elegant Tern	6	0.81	0.04	0.83	0.71	0.94
		Forster's Tern	4644	2.35	0.02	2.37	0.87	6.39
		Franklin's Gull	164	0.16	0.01	0.16	0.06	0.39
		Glaucous Gull	61	0.28	0.02	0.28	0.13	0.53
		Glaucous-winged Gull	30	0.27	0.03	0.23	0.14	0.95
		Gull-billed Tern	1	0.87	---	0.87	---	---
		Laughing Gull	10	0.25	0.07	0.26	0.09	0.72
		Least Tern	619	1.15	0.04	1.07	0.36	4.95
		Little Tern	7	0.72	0.17	0.76	0.36	1.55
		Mew Gull	2	0.12	0.03	0.12	0.10	0.15
		Ring-billed Gull	63	0.12	0.01	0.11	0.05	0.31
		Royal Tern	10	1.74	0.21	1.90	0.88	2.61
		Sooty Tern	10	0.18	0.03	0.22	0.07	0.36
		Western Gull	6	1.16	0.24	1.23	0.61	1.98

Table S8. *Blood-equivalent THg (µg/g ww) continued*.

Order	Family	Common name	*n*	Mean	SE	Median	5th percentile	95th percentile
	Recurvirostridae							
		American Avocet	4099	0.35	0.01	0.34	0.07	1.84
		Black-necked Stilt	1639	0.79	0.02	0.77	0.17	3.84
	Scolopacidae							
		Baird's Sandpiper	1	0.51	---	0.51	---	---
		Bar-tailed Godwit	3	0.34	0.13	0.39	0.19	0.57
		Black Turnstone	21	0.18	0.02	0.15	0.12	0.30
		Common Snipe	4	0.10	0.02	0.10	0.07	0.15
		Dunlin	280	0.18	0.01	0.19	0.06	0.45
		Hudsonian Godwit	3	0.22	0.07	0.17	0.15	0.39
		Long-billed Curlew	2	0.00	0.00	0.00	0.00	0.00
		Long-billed Dowitcher	104	0.36	0.03	0.45	0.10	1.00
		Pectoral Sandpiper	87	0.45	0.03	0.42	0.21	1.03
		Red Phalarope	181	0.24	0.02	0.23	0.06	1.01
		Red-necked Phalarope	141	0.18	0.01	0.17	0.06	0.52
		Rock Sandpiper	26	0.09	0.01	0.07	0.04	0.33
		Ruddy Turnstone	14	0.34	0.08	0.23	0.15	1.92
		Semipalmated Sandpiper	417	0.19	0.01	0.18	0.06	0.94
		Spotted Sandpiper	5	0.11	0.04	0.08	0.06	0.41
		Western Sandpiper	155	0.22	0.01	0.21	0.08	0.64
		Whimbrel	3	0.28	0.16	0.26	0.12	0.74
		Willet	61	0.78	0.14	0.54	0.14	7.38
		Wilson's Phalarope	12	0.66	0.17	0.49	0.26	2.55
Columbiformes								
	Columbidae							
		Mourning Dove	21	0.01	0.00	0.01	0.00	0.02
Falconiformes								
	Falconidae							
		American Kestrel	2	0.03	0.02	0.04	0.02	0.05
		Aplomado Falcon	30	0.32	0.05	0.36	0.07	0.98
		Peregrine Falcon	55	0.84	0.10	0.81	0.28	3.46
Galliformes								
	Odontophoridae							
		Northern Bobwhite	1	0.02	---	0.02	---	---
	Phasianidae							
		Ring-necked Pheasant	10	0.00	0.00	0.01	0.00	0.01
		Rock Ptarmigan	12	0.03	0.00	0.03	0.01	0.07
		Wild Turkey	2	0.02	0.00	0.02	0.02	0.02
Gaviiformes								
	Gaviidae							
		Common Loon	682	0.89	0.03	0.88	0.25	3.90
		Pacific Loon	68	0.43	0.05	0.42	0.09	2.21
		Red-throated Loon	112	0.45	0.04	0.43	0.18	1.83
		Yellow-billed Loon	177	0.64	0.04	0.60	0.20	2.37

Table S8. *Blood-equivalent THg (µg/g ww) continued.*

Order	Family	Common name	*n*	Mean	SE	Median	5th percentile	95th percentile
Gruiformes								
	Gruidae							
		Sandhill Crane	45	0.02	0.00	0.02	0.00	0.07
		Whooping Crane	8	0.15	0.06	0.14	0.04	0.63
	Rallidae							
		American Coot	729	0.19	0.01	0.17	0.04	1.70
		Clapper Rail	154	0.64	0.07	0.85	0.06	4.44
		Common Gallinule	1	0.06	---	0.06	---	---
		Sora	3	0.18	0.02	0.17	0.15	0.22
		Virginia Rail	3	1.70	0.12	1.63	1.55	1.91
Passeriformes								
	Alaudidae							
		Horned Lark	11	0.02	0.00	0.02	0.01	0.04
	Cardinalidae							
		Blue Grosbeak	1	0.01	---	0.01	---	---
		Lazuli Bunting	9	0.01	0.00	0.01	0.00	0.05
		Summer Tanager	1	0.09	---	0.09	---	---
		Western Tanager	1	0.08	---	0.08	---	---
	Cinclidae							
		American Dipper	50	0.09	0.01	0.09	0.03	0.29
	Corvidae							
		American Crow	1	0.03	---	0.03	---	---
	Emberizidae							
		Abert's Towhee	5	0.03	0.01	0.03	0.02	0.08
		Brewer's Sparrow	2	0.12	0.02	0.12	0.11	0.14
		Dark-eyed Junco	6	0.09	0.02	0.10	0.05	0.15
		Green-tailed Towhee	1	0.08	---	0.08	---	---
		Lincoln's Sparrow	22	0.06	0.01	0.05	0.01	0.22
		Savannah Sparrow	7	0.06	0.01	0.06	0.03	0.10
		Song Sparrow	20	0.14	0.03	0.15	0.03	0.44
		Spotted Towhee	2	0.05	0.01	0.05	0.04	0.06
		Vesper Sparrow	1	0.22	---	0.22	---	---
		White-crowned Sparrow	51	0.02	0.01	0.02	0.00	0.36
	Fringillidae							
		American Goldfinch	1	0.54	---	0.54	---	---
		Black Rosy-finch	9	0.19	0.03	0.18	0.13	0.40
		Gray-crowned Rosy-finch	6	0.17	0.01	0.19	0.13	0.19
		House Finch	1	0.03	---	0.03	---	---
		Pine Siskin	15	0.29	0.06	0.29	0.13	0.74
	Hirundinidae							
		Bank Swallow	5	0.25	0.11	0.17	0.11	1.02
		Barn Swallow	77	0.21	0.02	0.20	0.07	0.77
		Cliff Swallow	346	0.11	0.00	0.12	0.03	0.31
		Northern Rough-winged Swallow	4	0.05	0.00	0.05	0.04	0.06

Table S8. *Blood-equivalent THg (μg/g ww) continued*.

Order	Family	Common name	*n*	Mean	SE	Median	5th percentile	95th percentile
		Purple Martin	57	0.08	0.00	0.08	0.05	0.14
		Tree Swallow	1314	0.23	0.01	0.25	0.06	0.82
		Violet-green Swallow	1	0.11	---	0.11	---	---
	Icteridae							
		Brewer's Blackbird	1	0.19	---	0.19	---	---
		Brown-headed Cowbird	18	0.08	0.02	0.11	0.01	0.40
		Great-tailed Grackle	27	0.02	0.00	0.02	0.01	0.16
		Red-winged Blackbird	92	0.05	0.01	0.05	0.01	0.42
		Rusty Blackbird	187	0.14	0.01	0.15	0.02	0.74
		Western Meadowlark	8	0.02	0.00	0.02	0.01	0.05
		Yellow-headed Blackbird	151	0.04	0.00	0.05	0.01	0.14
	Laniidae							
		Loggerhead Shrike	1	0.03	---	0.03	---	---
	Mimidae							
		Gray Catbird	1	0.17	---	0.17	---	---
	Paridae							
		Black-capped Chickadee	31	0.03	0.01	0.02	0.00	0.36
		Mountain Chickadee	26	0.38	0.04	0.36	0.16	0.96
		Oak Titmouse	1	0.12	---	0.12	---	---
	Parulidae							
		Black-throated Gray Warbler	1	0.40	---	0.40	---	---
		Common Yellowthroat	10	0.12	0.02	0.13	0.06	0.23
		Macgillivray's Warbler	1	0.02	---	0.02	---	---
		Northern Waterthrush	26	0.15	0.02	0.14	0.08	0.40
		Orange-crowned Warbler	6	0.19	0.07	0.16	0.09	0.67
		Wilson's Warbler	7	0.21	0.03	0.22	0.13	0.30
		Yellow Warbler	23	0.12	0.02	0.12	0.05	0.31
		Yellow-breasted Chat	30	0.09	0.02	0.07	0.02	1.09
		Yellow-rumped Warbler	2	0.30	0.03	0.30	0.27	0.32
	Passeridae							
		House Sparrow	7	0.01	0.00	0.01	0.01	0.03
	Polioptilidae							
		Blue-gray Gnatcatcher	2	0.08	0.01	0.08	0.07	0.09
	Regulidae							
		Ruby-crowned Kinglet	9	0.18	0.05	0.16	0.07	0.49
	Sittidae							
		Red-breasted Nuthatch	2	0.45	0.11	0.47	0.37	0.57
	Sturnidae							
		European Starling	5	0.03	0.01	0.03	0.02	0.05
	Troglodytidae							
		Bewick's Wren	3	0.17	0.06	0.16	0.10	0.30
		Cactus Wren	2	0.17	0.02	0.17	0.15	0.19
		House Wren	698	0.19	0.00	0.21	0.05	0.46
		Marsh Wren	359	0.16	0.00	0.15	0.08	0.50

Table S8. *Blood-equivalent THg (µg/g ww) continued*.

Order	Family	Common name	*n*	Mean	SE	Median	5th percentile	95th percentile
	Turdidae							
		American Robin	10	0.15	0.07	0.26	0.02	1.02
		Gray-cheeked Thrush	21	0.03	0.00	0.03	0.02	0.07
		Mountain Bluebird	11	0.11	0.02	0.09	0.06	0.32
		Varied Thrush	16	0.02	0.01	0.02	0.01	0.17
		Western Bluebird	43	0.11	0.01	0.12	0.04	0.28
	Tyrannidae							
		Ash-throated Flycatcher	83	0.19	0.02	0.16	0.04	0.81
		Black Phoebe	2	0.16	0.11	0.20	0.09	0.31
		Dusky Flycatcher	4	0.62	0.11	0.69	0.42	0.84
		Olive-sided Flycatcher	3	0.18	0.04	0.21	0.12	0.24
		Vermilion Flycatcher	2	0.75	0.15	0.76	0.62	0.90
		Western Kingbird	5	0.19	0.19	0.05	0.03	2.27
		Willow Flycatcher	52	0.12	0.02	0.12	0.03	0.75
		Yellow-bellied Flycatcher	2	0.06	0.00	0.06	0.06	0.06
	Vireonidae							
		Bell's Vireo	5	0.81	0.05	0.82	0.69	0.94
		Warbling Vireo	11	0.09	0.01	0.09	0.05	0.20
Pelecaniformes								
	Ardeidae							
		Black-crowned Night-heron	237	0.29	0.02	0.29	0.06	1.25
		Cattle Egret	1	0.21	---	0.21	---	---
		Great Blue Heron	279	0.21	0.01	0.21	0.07	0.81
		Great Egret	4	0.38	0.10	0.31	0.27	0.75
		Least Bittern	3	0.13	0.02	0.15	0.10	0.16
		Little Blue Heron	10	0.19	0.05	0.13	0.08	0.87
		Reddish Egret	30	0.15	0.01	0.14	0.09	0.27
		Snowy Egret	73	0.29	0.03	0.33	0.04	1.57
		Tricolored Heron	119	0.19	0.01	0.21	0.07	0.40
	Pelecanidae							
		American White Pelican	100	0.68	0.08	0.57	0.11	9.92
		Brown Pelican	126	0.33	0.03	0.34	0.05	1.10
	Threskiornithidae							
		Roseate Spoonbill	9	0.46	0.07	0.46	0.27	0.82
		White-faced Ibis	361	0.12	0.00	0.11	0.05	0.38
Piciformes								
	Picidae							
		Hairy Woodpecker	1	0.17	---	0.17	---	---
		Northern Flicker	1	1.27	---	1.27	---	---
		Red-naped Sapsucker	3	0.06	0.03	0.06	0.03	0.11
Podicipediformes								
	Podicipedidae							
		Clark's Grebe	227	0.83	0.06	0.85	0.15	6.73
		Eared Grebe	416	0.33	0.02	0.29	0.06	1.73
		Horned Grebe	2	4.75	1.89	5.13	3.39	6.88

Table S8. *Blood-equivalent THg (µg/g ww) continued*.

Order	Family	Common name	*n*	Mean	SE	Median	5th percentile	95th percentile
		Pied-billed Grebe	48	0.37	0.03	0.37	0.20	0.77
		Red-necked Grebe	28	0.31	0.04	0.23	0.14	1.56
		Western Grebe	639	0.37	0.02	0.34	0.08	2.35
Procellariiformes								
	Diomedeidae							
		Black-footed Albatross	16	2.72	0.31	2.70	1.43	5.41
		Laysan Albatross	204	0.65	0.02	0.64	0.31	1.37
	Hydrobatidae							
		Fork-tailed Storm-petrel	3	1.38	0.33	1.28	0.98	2.06
		Leach's Storm-petrel	6	1.44	0.21	1.51	0.91	2.03
	Procellariidae							
		Northern Fulmar	13	1.89	0.30	2.07	0.79	4.20
Strigiformes								
	Strigidae							
		Ferruginous Pygmy-owl	5	0.05	0.01	0.03	0.03	0.11
		Great Horned Owl	2	0.19	0.05	0.20	0.15	0.24
		Northern Saw-whet Owl	3	0.90	0.14	1.03	0.69	1.07
	Tytonidae							
		Barn Owl	1	0.02	---	0.02	---	---
Suliformes								
	Phalacrocoracidae							
		Double-crested Cormorant	310	0.65	0.04	0.66	0.12	3.98
		Pelagic Cormorant	1	2.05	---	2.05	---	---
	Sulidae							
		Brown Booby	19	0.27	0.03	0.25	0.14	0.53

Table S9. Percentage of birds exceeding blood-equivalent total mercury concentrations (µg/g ww) in western North America. Data represent the sample size (*n*) and percentage of individual birds based on original raw data (*n*=27,629). Species are organized by order, family, and then alphabetically. Values are rounded to the nearest percent.

Order	Family	Common name	*n*	≥ 0.2 µg/g ww	≥ 0.5 µg/g ww	≥ 1.0 µg/g ww	≥ 2.0 µg/g ww	≥ 3.0 µg/g ww	≥ 4.0 µg/g ww
Accipitriformes									
	Accipitridae								
		Bald Eagle	365	97%	72%	30%	8%	4%	2%
		Cooper's Hawk	6	0%	0%	0%	0%	0%	0%
		Golden Eagle	2	0%	0%	0%	0%	0%	0%
		Hawaiian Hawk	5	0%	0%	0%	0%	0%	0%
		Northern Goshawk	3	0%	0%	0%	0%	0%	0%
		Northern Harrier	1	100%	0%	0%	0%	0%	0%
		Red-tailed Hawk	4	0%	0%	0%	0%	0%	0%
	Pandionidae								
		Osprey	241	30%	6%	2%	0%	0%	0%
Anseriformes									
	Anatidae								
		American Wigeon	2	50%	50%	50%	50%	0%	0%
		Barrow's Goldeneye	64	78%	2%	0%	0%	0%	0%
		Black Scoter	7	57%	0%	0%	0%	0%	0%
		Blue-winged Teal	52	35%	2%	0%	0%	0%	0%
		Brant	30	0%	0%	0%	0%	0%	0%
		Canada Goose	159	0%	0%	0%	0%	0%	0%
		Canvasback	36	86%	28%	0%	0%	0%	0%
		Cinnamon Teal	59	73%	7%	0%	0%	0%	0%
		Common Eider	102	39%	6%	0%	0%	0%	0%
		Common Goldeneye	3	100%	33%	0%	0%	0%	0%
		Common Merganser	2	50%	50%	50%	0%	0%	0%
		Emperor Goose	4	0%	0%	0%	0%	0%	0%
		Gadwall	82	39%	10%	0%	0%	0%	0%
		Greater Scaup	64	95%	69%	23%	2%	2%	0%
		Green-winged Teal	96	55%	24%	7%	2%	2%	2%
		Harlequin Duck	238	55%	16%	5%	1%	0%	0%
		Hooded Merganser	1	0%	0%	0%	0%	0%	0%
		King Eider	143	53%	6%	0%	0%	0%	0%
		Lesser Scaup	71	31%	8%	0%	0%	0%	0%
		Mallard	322	22%	5%	1%	0%	0%	0%
		Northern Pintail	14	36%	0%	0%	0%	0%	0%
		Northern Shoveler	109	83%	61%	48%	31%	19%	14%
		Red-breasted Merganser	5	100%	100%	60%	20%	0%	0%
		Redhead	47	38%	6%	0%	0%	0%	0%
		Ruddy Duck	38	11%	3%	0%	0%	0%	0%
		Snow Goose	64	0%	0%	0%	0%	0%	0%
		Spectacled Eider	248	8%	0%	0%	0%	0%	0%
		Steller's Eider	53	25%	4%	2%	0%	0%	0%
		Surf Scoter	203	33%	6%	0%	0%	0%	0%

Table S9. *Percentage exceeding blood-equivalent THg (µg/g ww) continued*.

Order	Family	Common name	*n*	≥ 0.2 µg/g ww	≥ 0.5 µg/g ww	≥ 1.0 µg/g ww	≥ 2.0 µg/g ww	≥ 3.0 µg/g ww	≥ 4.0 µg/g ww
		Trumpeter Swan	2	0%	0%	0%	0%	0%	0%
		White-winged Scoter	119	24%	4%	1%	0%	0%	0%
		Wood Duck	113	38%	28%	19%	1%	1%	0%
Charadriiformes									
	Alcidae								
		Cassin's Auklet	22	73%	0%	0%	0%	0%	0%
		Common Murre	239	60%	14%	1%	0%	0%	0%
		Crested Auklet	1	0%	0%	0%	0%	0%	0%
		Kittlitz's Murrelet	33	45%	0%	0%	0%	0%	0%
		Marbled Murrelet	57	54%	5%	0%	0%	0%	0%
		Parakeet Auklet	1	100%	0%	0%	0%	0%	0%
		Pigeon Guillemot	27	100%	100%	89%	48%	30%	4%
		Rhinoceros Auklet	21	100%	90%	48%	10%	0%	0%
		Thick-billed Murre	141	35%	6%	0%	0%	0%	0%
		Tufted Puffin	13	100%	15%	0%	0%	0%	0%
		Whiskered Auklet	1	100%	0%	0%	0%	0%	0%
	Charadriidae								
		American Golden-plover	50	30%	2%	0%	0%	0%	0%
		Black-bellied Plover	13	15%	0%	0%	0%	0%	0%
		Killdeer	136	37%	7%	1%	1%	0%	0%
		Mountain Plover	100	6%	1%	0%	0%	0%	0%
		Piping Plover	178	40%	12%	4%	2%	0%	0%
		Snowy Plover	132	92%	71%	29%	11%	7%	2%
	Haematopodidae								
		American Oystercatcher	40	70%	40%	8%	0%	0%	0%
	Laridae								
		Black Skimmer	69	99%	65%	52%	19%	13%	7%
		Black Tern	5	80%	0%	0%	0%	0%	0%
		Black-legged Kittiwake	1	100%	0%	0%	0%	0%	0%
		California Gull	689	33%	6%	1%	0%	0%	0%
		Caspian Tern	141	100%	96%	81%	28%	10%	6%
		Elegant Tern	6	100%	100%	0%	0%	0%	0%
		Forster's Tern	4644	100%	99%	93%	62%	33%	18%
		Franklin's Gull	164	35%	1%	0%	0%	0%	0%
		Glaucous Gull	61	79%	8%	2%	0%	0%	0%
		Glaucous-winged Gull	30	67%	17%	0%	0%	0%	0%
		Gull-billed Tern	1	100%	100%	0%	0%	0%	0%
		Laughing Gull	10	70%	20%	0%	0%	0%	0%
		Least Tern	619	99%	89%	53%	20%	9%	7%
		Little Tern	7	100%	57%	43%	0%	0%	0%
		Mew Gull	2	0%	0%	0%	0%	0%	0%
		Ring-billed Gull	63	11%	2%	0%	0%	0%	0%
		Royal Tern	10	100%	100%	80%	20%	0%	0%
		Sooty Tern	10	60%	0%	0%	0%	0%	0%
		Western Gull	6	100%	100%	67%	17%	0%	0%

Table S9. *Percentage exceeding blood-equivalent THg (µg/g ww) continued*.

Order	Family	Common name	*n*	≥ 0.2 µg/g ww	≥ 0.5 µg/g ww	≥ 1.0 µg/g ww	≥ 2.0 µg/g ww	≥ 3.0 µg/g ww	≥ 4.0 µg/g ww
	Recurvirostridae								
		American Avocet	4099	70%	36%	16%	4%	1%	0%
		Black-necked Stilt	1639	92%	69%	40%	17%	8%	5%
	Scolopacidae								
		Baird's Sandpiper	1	100%	100%	0%	0%	0%	0%
		Bar-tailed Godwit	3	67%	33%	0%	0%	0%	0%
		Black Turnstone	21	33%	5%	0%	0%	0%	0%
		Common Snipe	4	0%	0%	0%	0%	0%	0%
		Dunlin	280	48%	4%	0%	0%	0%	0%
		Hudsonian Godwit	3	33%	0%	0%	0%	0%	0%
		Long-billed Curlew	2	0%	0%	0%	0%	0%	0%
		Long-billed Dowitcher	104	71%	44%	6%	0%	0%	0%
		Pectoral Sandpiper	87	97%	40%	8%	1%	0%	0%
		Red Phalarope	181	55%	22%	6%	0%	0%	0%
		Red-necked Phalarope	141	44%	6%	2%	0%	0%	0%
		Rock Sandpiper	26	19%	4%	0%	0%	0%	0%
		Ruddy Turnstone	14	71%	29%	14%	7%	7%	0%
		Semipalmated Sandpiper	417	40%	14%	4%	0%	0%	0%
		Spotted Sandpiper	5	20%	0%	0%	0%	0%	0%
		Western Sandpiper	155	57%	10%	0%	0%	0%	0%
		Whimbrel	3	67%	33%	0%	0%	0%	0%
		Willet	61	79%	56%	36%	30%	25%	16%
		Wilson's Phalarope	12	92%	42%	25%	25%	8%	0%
Columbiformes									
	Columbidae								
		Mourning Dove	21	0%	0%	0%	0%	0%	0%
	Falconidae								
		American Kestrel	2	0%	0%	0%	0%	0%	0%
		Aplomado Falcon	30	73%	27%	7%	3%	0%	0%
		Peregrine Falcon	55	96%	73%	38%	15%	9%	4%
Galliformes									
	Odontophoridae								
		Northern Bobwhite	1	0%	0%	0%	0%	0%	0%
	Phasianidae								
		Ring-necked Pheasant	10	0%	0%	0%	0%	0%	0%
		Rock Ptarmigan	12	0%	0%	0%	0%	0%	0%
		Wild Turkey	2	0%	0%	0%	0%	0%	0%
Gaviiformes									
	Gaviidae								
		Common Loon	682	98%	79%	43%	16%	8%	5%
		Pacific Loon	68	79%	38%	18%	6%	4%	3%
		Red-throated Loon	112	89%	42%	13%	4%	3%	3%
		Yellow-billed Loon	177	94%	60%	26%	8%	2%	1%

Table S9. *Percentage exceeding blood-equivalent THg (µg/g ww) continued*.

Order	Family	Common name	*n*	≥ 0.2 µg/g ww	≥ 0.5 µg/g ww	≥ 1.0 µg/g ww	≥ 2.0 µg/g ww	≥ 3.0 µg/g ww	≥ 4.0 µg/g ww
Gruiformes									
	Gruidae								
		Sandhill Crane	45	0%	0%	0%	0%	0%	0%
		Whooping Crane	8	38%	13%	0%	0%	0%	0%
	Rallidae								
		American Coot	729	41%	18%	9%	4%	3%	2%
		Clapper Rail	154	79%	60%	42%	21%	11%	6%
		Common Gallinule	1	0%	0%	0%	0%	0%	0%
		Sora	3	33%	0%	0%	0%	0%	0%
		Virginia Rail	3	100%	100%	100%	0%	0%	0%
Passeriformes									
	Alaudidae								
		Horned Lark	11	0%	0%	0%	0%	0%	0%
	Cardinalidae								
		Blue Grosbeak	1	0%	0%	0%	0%	0%	0%
		Lazuli Bunting	9	0%	0%	0%	0%	0%	0%
		Summer Tanager	1	0%	0%	0%	0%	0%	0%
		Western Tanager	1	0%	0%	0%	0%	0%	0%
	Cinclidae								
		American Dipper	50	24%	0%	0%	0%	0%	0%
	Corvidae								
		American Crow	1	0%	0%	0%	0%	0%	0%
	Emberizidae								
		Abert's Towhee	5	0%	0%	0%	0%	0%	0%
		Brewer's Sparrow	2	0%	0%	0%	0%	0%	0%
		Dark-eyed Junco	6	0%	0%	0%	0%	0%	0%
		Green-tailed Towhee	1	0%	0%	0%	0%	0%	0%
		Lincoln's Sparrow	22	9%	0%	0%	0%	0%	0%
		Savannah Sparrow	7	0%	0%	0%	0%	0%	0%
		Song Sparrow	20	40%	5%	0%	0%	0%	0%
		Spotted Towhee	2	0%	0%	0%	0%	0%	0%
		Vesper Sparrow	1	100%	0%	0%	0%	0%	0%
		White-crowned Sparrow	51	16%	4%	2%	0%	0%	0%
	Fringillidae								
		American Goldfinch	1	100%	100%	0%	0%	0%	0%
		Black Rosy-finch	9	33%	0%	0%	0%	0%	0%
		Gray-crowned Rosy-finch	6	0%	0%	0%	0%	0%	0%
		House Finch	1	0%	0%	0%	0%	0%	0%
		Pine Siskin	15	87%	20%	0%	0%	0%	0%
	Hirundinidae								
		Bank Swallow	5	40%	20%	20%	0%	0%	0%
		Barn Swallow	77	53%	13%	1%	0%	0%	0%
		Cliff Swallow	346	19%	1%	0%	0%	0%	0%
		Northern Rough-winged Swallow	4	0%	0%	0%	0%	0%	0%
		Purple Martin	57	0%	0%	0%	0%	0%	0%

Table S9. *Percentage exceeding blood-equivalent THg (µg/g ww) continued*.

Order	Family	Common name	*n*	≥ 0.2 µg/g ww	≥ 0.5 µg/g ww	≥ 1.0 µg/g ww	≥ 2.0 µg/g ww	≥ 3.0 µg/g ww	≥ 4.0 µg/g ww
		Tree Swallow	1314	58%	19%	3%	1%	1%	0%
		Violet-green Swallow	1	0%	0%	0%	0%	0%	0%
	Icteridae								
		Brewer's Blackbird	1	0%	0%	0%	0%	0%	0%
		Brown-headed Cowbird	18	22%	0%	0%	0%	0%	0%
		Great-tailed Grackle	27	7%	0%	0%	0%	0%	0%
		Red-winged Blackbird	92	8%	3%	0%	0%	0%	0%
		Rusty Blackbird	187	36%	13%	2%	0%	0%	0%
		Western Meadowlark	8	0%	0%	0%	0%	0%	0%
		Yellow-headed Blackbird	151	1%	0%	0%	0%	0%	0%
	Laniidae								
		Loggerhead Shrike	1	0%	0%	0%	0%	0%	0%
	Mimidae								
		Gray Catbird	1	0%	0%	0%	0%	0%	0%
	Paridae								
		Black-capped Chickadee	31	19%	3%	0%	0%	0%	0%
		Mountain Chickadee	26	92%	31%	0%	0%	0%	0%
		Oak Titmouse	1	0%	0%	0%	0%	0%	0%
	Parulidae								
		Black-throated Gray Warbler	1	100%	0%	0%	0%	0%	0%
		Common Yellowthroat	10	20%	0%	0%	0%	0%	0%
		Macgillivray's Warbler	1	0%	0%	0%	0%	0%	0%
		Northern Waterthrush	26	23%	0%	0%	0%	0%	0%
		Orange-crowned Warbler	6	33%	17%	0%	0%	0%	0%
		Wilson's Warbler	7	71%	0%	0%	0%	0%	0%
		Yellow Warbler	23	17%	0%	0%	0%	0%	0%
		Yellow-breasted Chat	30	17%	7%	7%	0%	0%	0%
		Yellow-rumped Warbler	2	100%	0%	0%	0%	0%	0%
	Passeridae								
		House Sparrow	7	0%	0%	0%	0%	0%	0%
	Polioptilidae								
		Blue-gray Gnatcatcher	2	0%	0%	0%	0%	0%	0%
	Regulidae								
		Ruby-crowned Kinglet	9	44%	11%	0%	0%	0%	0%
	Sittidae								
		Red-breasted Nuthatch	2	100%	50%	0%	0%	0%	0%
	Sturnidae								
		European Starling	5	0%	0%	0%	0%	0%	0%
	Troglodytidae								
		Bewick's Wren	3	33%	0%	0%	0%	0%	0%
		Cactus Wren	2	0%	0%	0%	0%	0%	0%
		House Wren	698	53%	4%	2%	0%	0%	0%
		Marsh Wren	359	26%	5%	0%	0%	0%	0%

Table S9. *Percentage exceeding blood-equivalent THg (µg/g ww) continued.*

Order	Family	Common name	*n*	≥ 0.2 µg/g ww	≥ 0.5 µg/g ww	≥ 1.0 µg/g ww	≥ 2.0 µg/g ww	≥ 3.0 µg/g ww	≥ 4.0 µg/g ww
	Turdidae								
		American Robin	10	60%	10%	10%	0%	0%	0%
		Gray-cheeked Thrush	21	0%	0%	0%	0%	0%	0%
		Mountain Bluebird	11	18%	0%	0%	0%	0%	0%
		Varied Thrush	16	0%	0%	0%	0%	0%	0%
		Western Bluebird	43	23%	0%	0%	0%	0%	0%
	Tyrannidae								
		Ash-throated Flycatcher	83	45%	25%	4%	1%	0%	0%
		Black Phoebe	2	50%	0%	0%	0%	0%	0%
		Dusky Flycatcher	4	100%	75%	0%	0%	0%	0%
		Olive-sided Flycatcher	3	67%	0%	0%	0%	0%	0%
		Vermilion Flycatcher	2	100%	100%	0%	0%	0%	0%
		Western Kingbird	5	40%	40%	40%	20%	0%	0%
		Willow Flycatcher	52	17%	10%	4%	2%	0%	0%
		Yellow-bellied Flycatcher	2	0%	0%	0%	0%	0%	0%
	Vireonidae								
		Bell's Vireo	5	100%	100%	0%	0%	0%	0%
		Warbling Vireo	11	9%	0%	0%	0%	0%	0%
Pelecaniformes									
	Ardeidae								
		Black-crowned Night-heron	237	70%	22%	8%	1%	1%	0%
		Cattle Egret	1	100%	0%	0%	0%	0%	0%
		Great Blue Heron	279	51%	10%	3%	1%	0%	0%
		Great Egret	4	100%	25%	0%	0%	0%	0%
		Least Bittern	3	0%	0%	0%	0%	0%	0%
		Little Blue Heron	10	40%	20%	10%	0%	0%	0%
		Reddish Egret	30	27%	0%	0%	0%	0%	0%
		Snowy Egret	73	68%	26%	8%	1%	0%	0%
		Tricolored Heron	119	51%	2%	1%	0%	0%	0%
	Pelecanidae								
		American White Pelican	100	85%	57%	31%	15%	11%	10%
		Brown Pelican	126	79%	31%	7%	2%	2%	1%
	Threskiornithidae								
		Roseate Spoonbill	9	100%	33%	0%	0%	0%	0%
		White-faced Ibis	361	17%	3%	1%	0%	0%	0%
Piciformes									
	Picidae								
		Hairy Woodpecker	1	0%	0%	0%	0%	0%	0%
		Northern Flicker	1	100%	100%	100%	0%	0%	0%
		Red-naped Sapsucker	3	0%	0%	0%	0%	0%	0%
Podicipediformes									
	Podicipedidae								
		Clark's Grebe	227	90%	70%	44%	16%	11%	9%
		Eared Grebe	416	62%	39%	19%	3%	1%	0%
		Horned Grebe	2	100%	100%	100%	100%	100%	50%

Table S9. *Percentage exceeding blood-equivalent THg (μg/g ww) continued*.

Order	Family	Common name	*n*	≥ 0.2 μg/g ww	≥ 0.5 μg/g ww	≥ 1.0 μg/g ww	≥ 2.0 μg/g ww	≥ 3.0 μg/g ww	≥ 4.0 μg/g ww
		Pied-billed Grebe	48	94%	29%	2%	0%	0%	0%
		Red-necked Grebe	28	64%	18%	14%	4%	0%	0%
		Western Grebe	639	66%	38%	18%	7%	3%	2%
Procellariiformes									
	Diomedeidae								
		Black-footed Albatross	16	100%	100%	100%	75%	44%	19%
		Laysan Albatross	204	100%	74%	17%	0%	0%	0%
	Hydrobatidae								
		Fork-tailed Storm-petrel	3	100%	100%	67%	33%	0%	0%
		Leach's Storm-petrel	6	100%	100%	83%	17%	0%	0%
	Procellariidae								
		Northern Fulmar	13	100%	100%	77%	54%	23%	15%
Strigiformes									
	Strigidae								
		Ferruginous Pygmy-owl	5	0%	0%	0%	0%	0%	0%
		Great Horned Owl	2	50%	0%	0%	0%	0%	0%
		Northern Saw-whet Owl	3	100%	100%	67%	0%	0%	0%
	Tytonidae								
		Barn Owl	1	0%	0%	0%	0%	0%	0%
Suliformes									
	Phalacrocoracidae								
		Double-crested Cormorant	310	87%	62%	31%	12%	8%	5%
		Pelagic Cormorant	1	100%	100%	100%	100%	0%	0%
	Sulidae								
		Brown Booby	19	74%	16%	0%	0%	0%	0%

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