Appendix A for:

Understanding drivers of mercury in lake trout (*Salvelinus namaycush*), a top-predator fish in southwest Alaska's parklands

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Overview of Methods

In this study, we assessed concentrations of mercury (Hg) in lake trout (*Salvelinus namaycush*) from 14 lakes in two National Parks: Katmai National Park and Preserve (KATM) and Lake Clark National Park and Preserve (LACL). Our goals were (1) to evaluate the magnitude of Hg contamination in fish within these lakes, and (2) to determine the relative importance of factors pertaining to loading, methylation, bioaccumulation, and biomagnification in controlling variability of fish Hg concentrations among lakes. To accomplish these goals, we collected water, plankton, and fish in the field, and then analyzed the samples in the lab for Hg and other constituents. In addition to the samples collected in the field and analyzed in the lab, we quantified several factors from pre-existing (often remote sensing) data. Our analyses of water, plankton, and fish samples, and the summaries of pre-existing datasets, produced a large suite of factors, some of which were highly correlated. Therefore, we used principal components analyses to exclude redundant factors. This process resulted in 12 factors selected as covariates for a Bayesian hierarchical model that matched the structure of our conceptual model and data collection.

This appendix provides additional details about the methods used in our study. It also contains tables and figures referenced but not included in the main manuscript, such as Tables A.1, A.2, and A.3 and Figures A.1, A.2, and A.3.

Study Sites

Fourteen lakes were selected as study sites in the two parks. While these lakes vary in area and depth, from 1 to 311 km^2 and from 19 to 266 m, respectively, all are oligotrophic, with low concentrations of nutrients and major ions, and low to moderate acid buffering capacity (Brabets and Ourso, 2006a, 2006b; Chamberlain, 1989; LaPerriere, 1997; Wilkens, 2002). Their stratification patterns are characterized as dimictic or cold polymictic, freezing at least temporarily during winter and stratifying at least weakly during summer. Periodic wind-driven upwelling keeps hypolimnetic water well oxygenated (6-13 $mg \cdot L^{-1}$; Table A.4).

Water Methods

We determined lake profile structure near the midpoint of each lake during the summer of 2016, using a YSI EXO2 multi-parameter sonde that simultaneously recorded water depth, pH, temperature, conductance, dissolved oxygen, and turbidity from the lake surface to the bottom or 50 m depth (whichever was shallower). Using this information, water samples were collected from depths above, within, and below the thermocline via a Teflon-coated, remote-triggered Niskin sampler and new 2-L polyethylene terephthalate glycol-modified (PETG) bottles. Following collection, samples were filtered with pre-ashed quartz fiber filters (0.45 µm). Filter-passing water was poured into 500 mL and 250 mL subsamples and preserved with 1% hydrochloric acid for later total Hg (THg) and methyl-Hg (MeHg) analyses, respectively. Additional filter-passing water was collected in amber glass vials and stored at 4 °C for later measurement of dissolved organic carbon (DOC) and sulfate (SO_4^{2-}).

We analyzed THg, MeHg, and DOC concentrations at the United States Geological Survey Mercury Research Laboratory (USGS-MRL) using modified versions of Methods 1631, 1630, and 9060a by the United States Environmental Protection Agency (USEPA, 1998a, 2002, 2004). Concentrations of SO_4^{2-} were analyzed at the University of Wisconsin, Madison using USEPA Method 300 (USEPA, 1997) and a Dionex 2100 ion chromatography system fitted with an AS11 column. All analyses passed established lab quality control criteria.

To lower detection limits for MeHg, we used dedicated sample bottles (only used for extremely low-level waters) and batch-analysis of samples (separated from higher-level MeHg ecosystems), as described by Ogorek et al. (2021). We grouped depths by lake during analysis and increased the vigor and frequency of cleaning procedures for supplies and equipment. These measures improved the MeHg method detection limit from 0.040 $ng \cdot L^{-1}$ to 0.010 $ng \cdot L^{-1}$ (Lepak et al., 2015). However, MeHg concentrations in filtered water from many lakes were below this threshold, so we report these values as approximations. Quality assurance metrics for analytes measured in water samples, including MeHg, are included in Table A.5.

Plankton Methods

We collected bulk plankton from the top 20 m of the water column near the midpoint of each lake using a 1 m diameter, 63 µm mesh net during the summer of 2016. Once collected, plankton were sieved using 20 cm^2 size-sequential Nitex screens (500, 243, 118, and 63 µm) and frozen on the date of collection. Frozen plankton captured on the Nitex screens were transported to the USGS-MRL and lyophilized.

At the lab, we measured the mass of dried plankton captured on each screen. Samples were then removed from the screens and prepared for MeHg analysis via a 4.5 M nitric acid extraction, using methods described by Hammerschmidt and Fitzgerald (2006). Subsequently, an aliquot of the extractant was analyzed for MeHg concentration directly by ethylation with sodium tetraethylborate, purge and trap analyte capture, and cold vapor atomic fluorescence spectrometry. Analyses of plankton met USGS-

MRL quality control criteria. Recoveries of standard reference material (SRM) IAEA 452 were consistently within 10% of reported values, reagent blanks were negligible, and a secondary standard for verifying instrument calibration was within 10% of the expected concentration.

Plankton MeHg concentrations pertained to a single bulk sample per lake, with each individual size fraction (>500, 243-500, 118-243, and 63-118 µm) normalized relative to its mass contribution to the bulk sample as:

$$Bulk\ MeHg = \frac{\sum_{i=1}^{4}(MeHg_i \cdot Mass_i)}{\sum_{i=1}^{4}(Mass_i)}$$

where *i* = one of the four size fractions and $Mass$ = the weight of that size fraction in grams (g). See Table A.6 for plankton-related analysis results.

Calculating the bioaccumulation factor (BAF) for size-sieved plankton in a given lake required two types of data: (1) the MeHg content of the smallest size fraction (63-118 µm) of plankton ($MeHg_{plankton}$, $ng{\cdot}g^{-1}$ dw), and (2) the MeHg content of filter-passing water ($MeHg_{water}$, $ng{\cdot}L^{-1}$):

$$BAF = log_{10}\frac{\left[MeHg_{plankton}(ng \cdot kg^{-1}dw)\right]}{\left[MeHg_{water}(ng \cdot L^{-1}dw)\right]},$$

However, many of the $MeHg_{water}$ concentrations were at or below our method detection limit (0.010 $ng{\cdot}L^{-1}$), making these estimations challenging. Since benthic fluxes of filter-passing THg and MeHg were not observed in the lake profile data, we elected to average the MeHg concentrations for the epilimnion and thermocline layers, including approximations, to provide a more conservative approximation.

Fish Methods

Due to financial and logistical constraints, and a desire to minimize mortality of a long-lived species, we incorporated archived (previously frozen) lake trout samples from some lakes (Table A.7). As a result, a temporal disconnect exists between fish collections (2011 – 2016) and water and plankton collections (2016), which in turn may impact the comparability of analytes sampled in different years. Seasonal and inter-annual variability exists for some analytes but, for the purposes of this study, we assumed the values measured are best estimates for the entire study window.

After fish were caught, axial muscle tissue samples generally were removed and frozen (<-20°C) until laboratory analysis, although fish collected in 2011 and 2012 were frozen whole, and later thawed for tissue sampling. In either case, thawed tissue samples were lyophilized and homogenized and moisture content was determined, prior to analysis.

THg analysis was conducted at the USGS-MRL or USGS Contaminant Ecology Research Lab using direct combustion and atomic absorbance spectroscopy following USEPA Method 7473 (USEPA, 1998b). As with plankton, analyses of fish met established quality control criteria. Recoveries of SRM IAEA 407 were 100 ± 6%, reagent blanks were negligible, and triplicate analysis performed once every 10 samples achieved a relative standard deviation of <10%.

The homogenized tissue samples were also analyzed for carbon and nitrogen stable isotope ratios ($\delta^{13}C$ and $\delta^{15}N$, respectively), which serve as time-integrated indicators of a consumer's foraging ecology (Perga and Gerdeaux, 2005). Specifically, $\delta^{13}C$ can be used to estimate reliance on different carbon sources (e.g., benthic vs. pelagic), while $\delta^{15}N$ can be used to estimate trophic position (Cabana and Rasmussen, 1994; Post, 2002) and, where salmon are present, marine-derived nitrogen (Kline et al., 1990; Naiman et al., 2002). The δ notation indicates the difference between a sample and a standard (Peterson and Fry, 1987), and is defined by the following equation:

$$\delta^{13}C \ or \ \delta^{15}N \ = \left[\left(\frac{R_{sample}}{R_{standard}}\right) - 1\right] \times 1000$$

where R is the ratio of the heavy to light isotope (^{13}C:^{12}C or ^{15}N:^{14}N) and standards are Vienna Peedee Belemnite for C and air for N. Analysis of $\delta^{13}C$ and $\delta^{15}N$ was conducted at the University of California Davis Stable Isotope Facility on a continuous flow isotope ratio mass spectrometer. SRMs included Bovine Liver, Nylon 5, Glutamic Acid, and Enriched Alanine, and results met lab standards (± 0.03‰). Triplicate analysis, run on 10% of samples, consistently achieved a relative standard deviation of <1%.

To account for the δ13C fractionation associated with lipid formation in fish, a mathematical lipid correction was applied to the lake trout raw $\delta^{13}C$ values and labeled as $\delta^{13}C_{\text{lipid-free}}$ (Table A.7). The correction followed Eq. 4 from Hoffman et al., 2015:

$$\delta^{13}C_{lipid-free} = \ \delta^{13}C_{raw} + \frac{\left(-6.5 * (3.8 - C{:}N_{raw})\right)}{C{:}N_{raw}}$$

where -6.5 and 3.8 were Hoffman et al.'s derived values for $\Delta\delta^{13}C_{lipid}$ and $C{:}N_{raw}$, respectively. Quality assurance data for analysis of $\delta^{13}C$ and $\delta^{15}N$ in lake trout samples are included in Table A.8.

GIS Methods

Several factors quantified for this study were based on pre-existing, rather than original, data. For example, volcano proximity, glacier cover, and wetland cover were derived from remote sensing data using Geographic Information Systems (GIS).

Volcano proximity was quantified for each lake as a unitless index, similar to that developed by Gustafson and Parker (1992). The index used the distance (d) between all volcano (v) and lake (l) pairs, filtered to include only distances <100 km, then summed by lake:

$$Volcano\ proximity = \sum_{l=1}^{14} \frac{1}{d_{vl}^2}$$

so higher proximity index values signified more volcanoes nearby. Distances were calculated via the Near tool in ArcMap (v 10.7.1) from the point representing the center of the volcano (AKDNR, 2011) to the closest point on the lake edge (NPS, 2006). We defined the radius as 100 km to approximate the distance gaseous elemental Hg (Hg^0) from volcanoes might travel. We focused on Hg^0 because most naturally emitted Hg is Hg^0 (UNEP, 2013), including that from volcanoes (Bagnato et al., 2007) and geothermal features (Hall et al., 2006). The exact travel distance will likely depend on the volcano altitude, wind strength, and plume size, in addition to the Hg form emitted (i.e., gaseous elemental, gaseous oxidized, or particle-bound).

Glacier cover was calculated for each lake basin using shapefiles of glacial area within the parks at two time intervals: current (2000's) and historical (1950's) (Arendt and Rich, 2013). Specifically, glacial area was summed across glacier types within a basin, and the sums were divided by the total basin area (USGS, 2019) to calculate percent cover for each time interval. Glacier loss was calculated as the difference between current and historical glacier cover in a lake's basin.

Wetland cover was calculated for each lake basin using shapefiles of wetland area from the National Wetlands Inventory (NWI; USFWS, 2011), where available. Like glacier area, wetland area was summed across wetland types within a basin and then divided by basin area. For basins where NWI data were not available, wetland cover was estimated from mean basin slope (NPS, 2009), via a relationship developed in 21 nearby basins where NWI and slope data existed (R^2 = 0.92, $p < 0.01$; Figure A.4).

GIS methods for glacier and wetland cover relied on lake basin boundaries. Existing boundaries from the USGS Watershed Boundary Dataset (WBD; USGS, 2019) were sufficient for 6 of the 14 lakes (i.e., Telaquana, Kontrashibuna, Clark, Kukaklek, Nonvianuk, and Hammersly). For the other eight lakes, the existing WBD perimeter needed to be revised, typically because the downstream-most point was well below the lake outlet. For those eight lakes, we used two alternative data sources as guides for revising the downstream perimeter of the WBD boundary. Specifically, we used an older basin boundary geodatabase where available (NPS, 2006); where the geodatabase was unavailable, we used the contour lines from a raster image of a scanned USGS topological map (1:63,360 scale; USGS, 2007).

Covariate Selection

Methods thus far produced 13 fish-level and 21 lake-level factors for potential use as covariates in the Bayesian hierarchical model (Table A.9). Given the sample size – particularly at the lake level – we needed to reduce the pool of covariates to a manageable number.

The number of fish-level covariates was reduced by omitting those with a large number of undetermined values (e.g., sex) or no clear link to a particular process (e.g., latitude, longitude). Age, length, and weight were highly correlated, so we selected the covariate mostly strongly related to fish total Hg (i.e., age). To reduce the number of lake-level covariates, we performed separate principal component analyses (PCA) for each of three processes: loading, methylation, and biomagnification. We then selected non-redundant covariates that best explained each of the two main axes in the PCA biplots. Redundancy was identified by visually identifying covariates with similar vectors in each biplot. From the groups of redundant covariates, we chose the covariate with the highest loading and/or the clearest mechanistic justification. In the loading biplot, two covariates with clear and distinct mechanistic justifications (volcano proximity and spawning density) presented similar vectors. We verified that these covariates were not highly correlated before including both. We also examined variance inflation factors in the model.

Bayesian Hierarchical Model

Observations of total Hg concentration (y_i) in lake trout ($i = 1...N$ fish) were modeled as a lognormal variable.

$$y_i = e^{z_i}$$

$$z_i \sim \mathcal{N}(\hat{z}_i, \sigma_1^2)$$

The expected value ($\hat{z}_i$) was a function of a random intercept ($\alpha_{1,j}, j = 1...L$ lakes) and individual-level charactersitics, where $\mathbf{X}$ is the $i \times k$ matrix of fish-level covariate values and $\boldsymbol{\alpha}$ is the $k \times j$ matrix of lake-varying random intercepts and regression coefficients to be estimated.

$$\hat{z}_i = \boldsymbol{X}_i \boldsymbol{\alpha}_{\mathbf{j[i]}}$$

Lake-varying intercept and slope random effects were modeled as draws from a multivariate normal distribution centered on a lake-specific predicted intercept ($\beta_{1,j}$) and regional average slopes ($\beta_{2:5}$).

$$\begin{pmatrix} \alpha_{1,j} \\ \alpha_{2,j} \\ \alpha_{3,j} \\ \alpha_{4,j} \\ \alpha_{5,j} \end{pmatrix} \sim \mathcal{MVN}\begin{pmatrix} \beta_{1,j} \\ \beta_2 \\ \beta_3 \; , \Sigma \\ \beta_4 \\ \beta_5 \end{pmatrix}$$

The lake-varying intercept was, in turn, predicted by an intercept (λ_1) and two lake-level covariates: fish species richness (λ_2) and plankton MeHg concentration (λ_3), where $\boldsymbol{W}$ is a $j \times 3$ matrix containing observations of fish species richness and plankton MeHg at each lake.

$$\beta_{1,j} = \boldsymbol{W_j} \boldsymbol{\lambda}$$

We expect that any lake level-variability in loading or methylation would influence plankton MeHg and subsequently lake trout Hg, so $m - 1$ different lake-level variables related to loading, methylation, and bioaccumulation were used to predict plankton MeHg (W_2) which was measured in j lakes. Let $\boldsymbol{U}$ be a $j \times m$ matrix of observations of m covariates at j lakes and an intercept dummy variable, and $\boldsymbol{\theta}$ be an m-length vector of regression coefficients to be estimated.

$$W_{2j} \sim \mathcal{N}\left(\widehat{W}_{2j}, \sigma_2^2\right)$$

$$\widehat{W}_{2j} = \boldsymbol{U_j} \boldsymbol{\theta}$$

Indicator Variable Selection

Lake-level covariates were selected using indicator variable selection (Hooten and Hobbs, 2015; Kuo and Mallick, 1998). Specifically, we used a random effect variant of the Kuo and Mallick model, as described by O'Hara and Sillanpää (2009). To implement this, the covariate effects ($\boldsymbol{\lambda}, \boldsymbol{\theta}$) in the above model are the combination of the estimated covariate effect ($\boldsymbol{\nu}, \boldsymbol{\eta}$) and an indicator variable (I_2, I_2).

$$\lambda_l = I_{1,l} \nu_l$$

$$I_{1,l} \sim \text{Bernoulli}(p_1)$$

$$\theta_m = I_{2,m} \eta_m$$

$$I_{2,m} \sim \text{Bernoulli}(p_2)$$

The indicator variables were Bernoulli variables with probabilities (p_2, p_3) that were estimated as hyperparameters. The indicator variable for each covariate could take a value of 0 or 1 in each Markov chain Monte Carlo (MCMC) sample, effectively excluding or including the covariate. In this way, the mean of the indicator (I) for each covariate represents an inclusion probability for that covariate, informed by the data. To implement the random effects approach, which improves mixing, we placed a level-specific (lake-level, plankton-MeHg-level) hyperprior on the variance of each covariate effect (Cunningham et al., 2018). This constrained the covariate effect estimates to remain in a reasonable range when I = 0 and that covariate is decoupled from the likelihood.

$$\nu_l \sim \mathcal{N}(0, \varsigma_\nu^2)$$

$$\varsigma_\nu \sim Uniform(0,20)$$

$$\eta_m \sim \mathcal{N}\left(0, \varsigma_\eta^2\right)$$

$$\varsigma_\eta \sim Uniform(0,20)$$

Prior probabilities for all parameters were diffuse or weakly informative (Table A.10). We fit our model with JAGS (Plummer, 2017), via the JagsUI package (Kellner and Meredith, 2021) in R Statistical Software (R Core Team, 2019). Three MCMC chains were burned in for 5000 iterations, or until the Gelman-Rubin statistic was less than 1.1, indicating convergence.

Model Adequacy

We assessed the adequacy of model fit with posterior predictive checks (Gelman and Hill, 2007) of the mean and standard deviation of lake trout THg and plankton MeHg concentrations (Table A.11), and by graphically examining realizations of posterior predictive distributions alongside observed data (Figure A.5). At each step of the MCMC, we simulated a full dataset (y_{rep}, W_{2rep}) from our model and the parameter values at that step. We examined discrepancies (i.e., how frequently summaries of the simulated data exceeded summaries of the observed data; Table A.11), and graphically examined simulated datasets compared to the observed dataset. Model fit was generally good but did not capture the extreme peak at the mode of the observed data (Figure A.5), leading to larger standard deviations in most simulated data sets compared to the observed data.

Disclaimer

Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government. Data collected for this study are available at https://doi.org.10.5066/P9UEP9C5.

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Tables

Table A.1. Names of the 24 volcanoes that are within 100 km of at least one of the 14 lakes in this study. General locations and periods of activity are also listed, based primarily on AVO 2016.

Volcano name	In park boundaries? [A]	Activity over time
Douglas	Yes - KATM	Historically active [B]
Griggs	Yes - KATM	Historically active [B]
Iliamna	Yes - LACL	Historically active [B]
Kukak	Yes - KATM	Historically active [B]
Mageik	Yes - KATM	Historically active [B]
Martin	Yes - KATM	Historically active [B]
Redoubt	Yes - LACL	Historically active [B]
Snowy	Yes - KATM	Historically active [B]
Trident	Yes - KATM	Historically active [B]
Cerberus	Yes - KATM	Historically active [B]
Falling Mt.	Yes - KATM	Historically active [B]
Fourpeaked	Yes - KATM	Historically active [B]
Katmai	Yes - KATM	Historically active [B]
Novarupta	Yes - KATM	Historically active [B]
Devils Desk	Yes - KATM	[C]
Kejulik	Yes - KATM	[C]
Dennison	Yes - KATM	[D]
Kaguyak	Yes - KATM	[D]
Spurr	No	Historically active [B]
Augustine	No	Historically active [B]
Crater Peak	No	Historically active [B]
Peulik	No	Historically active [B]
Ugashik	No	Historically active [B]
Ukinrek	No	Historically active [B]

[A] LACL = Lake Clark National Park and Preserve; KATM = Katmai National Park and Preserve.

[B] Volcanoes defined as “historically active” by Cameron et al. (2018) meet at least one of the following criteria since 1700 CE: (1) a documented unquestioned eruption, (2) a strongly suspected eruption, often documented in a historical account with very little information, but never contradicted by current geologic knowledge, (3) persistent (usually on the order of decades but certainly longer than several months) fumaroles, with temperatures (where measured) within ~10 °C of the boiling point, (4) significant, measured, volcanic-related, non-eruptive deformation, or (5) documented earthquake swarm with strongly suspected volcanic cause.

[C] Active within the last 2,000,000 years, but not within the last 10,000 years.

[D] Active in the Holocene.

Table A.2. Characteristics of the 14 study lakes and their surrounding basins, listed along a north-to-south gradient.

Park [A]	Lake name	Latitude (°W) [B]	Longitude (°N) [B]	Area		Elevation		Maximum depth (m)	Salmon presence (yes/no)
				Lake (km^2)	Basin (km^2)	Lake (m)	Basin (m) [C]		
LACL	Telaquana	60.95437	-153.88487	46.67	406.34	372	984	133	yes
LACL	Turquoise	60.78813	-153.94295	13.41	179.31	763	1385	120	no
LACL	Snipe	60.62563	-154.29925	3.21	21.00	559	610	19	no
LACL	Lachbuna	60.48659	-154.01400	3.33	361.37	407	954	40	no
LACL	Crescent	60.37177	-152.93722	16.02	315.13	183	842	31	yes
LACL	Kijik	60.30074	-154.32701	4.53	106.98	114	622	108	yes
LACL	Kontrashibuna	60.17657	-154.03947	20.09	482.39	140	830	114	no
LACL	Clark	60.33716	-154.32719	311.16	7614.64	77	606	266	yes
KATM	Kukaklek	59.17017	-155.34117	173.72	1191.05	247	433	79	yes
KATM	Nonvianuk	58.99904	-155.38396	132.35	957.07	198	530	35	yes
KATM	Kulik	58.95398	-154.96440	27.98	587.63	201	686	98	yes
KATM	Hammersly	58.84376	-155.13308	8.79	158.03	487	776	58	yes
KATM	Grosvenor	58.67384	-155.25739	73.87	1969.82	33	407	112	yes
KATM	Brooks	58.50466	-155.92045	75.53	774.55	19	232	82	yes

[A] LACL = Lake Clark National Park and Preserve; KATM = Katmai National Park and Preserve.

[B] Latitude and longitude specify the lake centroid location in decimal degrees.

[C] Basin elevation represents a mean value, averaged within the basin boundary.

Table A.3. Analytes measured in filter-passing water collected from various depths at 14 study lakes in 2016. Analytes include total mercury (THg), methylmercury (MeHg), dissolved organic carbon (DOC), and dissolved sulfate (SO_4^{2-}). MeHg values are generally below the method detection limit (0.010 ng·L^{-1}) and thus should be considered as approximates.

Park [A]	Lake name	Layer	Depth (m)	THg (ng·L^{-1})	MeHg (ng·L^{-1})	DOC (mg·L^{-1})	SO_4^{2-} (mg·L^{-1})
LACL	Telaquana	Epilimnion	2	0.150	0.010	0.393	13.203
LACL	Telaquana	Thermocline	12	0.277	0.012	0.306	13.062
LACL	Telaquana	Hypolimnion	60	0.115	0.185	0.312	14.102
LACL	Turquoise	Epilimnion	2	0.193	0.003	0.186	4.493
LACL	Turquoise	Thermocline	8	0.183	0.003	0.214	4.535
LACL	Turquoise	Hypolimnion	30	0.223	0.000	0.164	4.818
LACL	Snipe	Epilimnion	2	0.195	0.036	2.357	5.043
LACL	Snipe	Thermocline	5	0.242	0.016	2.379	4.778
LACL	Snipe	Hypolimnion	10	0.163	0.015	2.259	4.823
LACL	Lachbuna	Epilimnion	2	0.175	0.006	0.452	10.845
LACL	Lachbuna	Thermocline	4	0.136	0.005	0.451	10.892
LACL	Lachbuna	Hypolimnion	20	0.143	0.005	0.431	13.623
LACL	Crescent	Epilimnion	5	0.497	0.008	0.303	1.914
LACL	Crescent	Thermocline	10	0.430	0.007	0.259	1.919
LACL	Crescent	Hypolimnion	25	0.491	0.001	0.233	1.847
LACL	Kijik	Epilimnion	2	0.178	0.003	0.575	9.497
LACL	Kijik	Thermocline	12 [B]	0.177	0.008	0.557	9.741
LACL	Kijik	Hypolimnion	70	0.120	0.007	0.525	10.056
LACL	Kontrashibuna	Epilimnion	2	0.266	0.000	0.290	8.404
LACL	Kontrashibuna	Thermocline	14	0.149	0.004	0.256	8.044
LACL	Kontrashibuna	Hypolimnion	60	0.120	0.006	0.295	9.435
LACL	Clark	Epilimnion	10 [B]	0.206	0.003	0.813	6.595
LACL	Clark	Thermocline	25	0.190	0.002	[C]	[C]
LACL	Clark	Hypolimnion	70	0.223	0.000	[C]	[C]
KATM	Kukaklek	Epilimnion	10	0.113	0.003	[C]	[C]
KATM	Kukaklek	Thermocline	21	0.144	0.005	0.855	7.512
KATM	Kukaklek	Hypolimnion	40	0.176	0.077	0.809	6.604
KATM	Nonvianuk	Epilimnion	12.5	0.119	0.009	0.924	7.315
KATM	Nonvianuk	Thermocline	25	0.119	0.010	0.800	7.922
KATM	Nonvianuk	Hypolimnion	30	0.126	0.007	0.876	7.842
KATM	Kulik	Epilimnion	5	0.142	0.002	0.440	7.700
KATM	Kulik	Thermocline	15	0.132	0.001	0.476	7.287
KATM	Kulik	Hypolimnion	28	0.191	0.004	0.431	6.713
KATM	Hammersly	Epilimnion	7.5 [B]	0.239	0.004	0.618	2.913
KATM	Hammersly	Thermocline	17.5	0.214	0.002	0.612	3.445
KATM	Hammersly	Hypolimnion	30	0.216	0.005	0.597	3.163

Park [A]	Lake name	Layer	Depth (m)	THg ($ng \cdot L^{-1}$)	MeHg ($ng \cdot L^{-1}$)	DOC ($mg \cdot L^{-1}$)	SO_4^{2-} ($mg \cdot L^{-1}$)
KATM	Grosvenor	Epilimnion	7	0.233	0.011	1.092	4.019
KATM	Grosvenor	Thermocline	17	0.204	0.025	1.074	4.224
KATM	Grosvenor	Hypolimnion	45	0.185	0.026	1.104	4.234
KATM	Brooks	Epilimnion	8	0.172	0.012	1.487	3.362
KATM	Brooks	Thermocline	19	0.209	0.016	1.490	2.956
KATM	Brooks	Hypolimnion	45	0.210	0.019	1.435	2.674

[A] LACL = Lake Clark National Park and Preserve; KATM = Katmai National Park and Preserve.

[B] Field duplicates were collected at this depth so results in this row are mean values. See Table A.5 for details.

[C] No data, due to sample loss (Kukaklek) or lack of sample bottles (Clark).

Table A.4. Ranges in dissolved oxygen (DO) concentrations ($mg \cdot L^{-1}$) and saturation (%) along vertical profiles at 14 lakes in the year 2016. Profile dates and maximum depths are also provided. Profile data for additional years and parameters are available at https://irma.nps.gov/aqwebp/.

Park [A]	Lake name	Date profiled	Min DO ($mg \cdot L^{-1}$)	Max DO ($mg \cdot L^{-1}$)	Min DO (% sat)	Max DO (% sat)	Max depth (m)
LACL	Telaquana	7/20/2016	9.2	11.5	86.5	104.4	126.8
LACL	Turquoise	7/20/2016	7.6	11.1	76.7	93.5	103.1
LACL	Snipe	7/18/2016	7.7	9.6	86.6	98.4	9.1
LACL	Lachbuna	7/18/2016	6.4	10.8	71.8	99.1	36.9
LACL	Crescent	7/19/2016	7.2	11.4	74.2	98.2	22.6
LACL	Kijik	7/19/2016	8.3	12.8	79.5	115.9	96.3
LACL	Kontrashibuna	7/20/2016	8.9	12.1	90.2	104.7	112.2
LACL	Clark [B]	7/22/2016	9.1	12.4	91.2	103.8	101.2
KATM	Kukaklek	7/27/2022	8.2	11.2	84.1	96.7	61.8
KATM	Nonvianuk	7/26/2016	6.9	10.2	60.6	96.5	32.4
KATM	Kulik	7/26/2016	8.6	11.1	88.6	95.5	36.9
KATM	Hammersly	7/25/2016	7.2	10.6	77.2	94.4	49.2
KATM	Grosvenor	7/25/2016	8.9	11.6	90.1	101.9	69.5
KATM	Brooks	7/26/2016	9.1	12.1	74.3	103.5	72.6

[A] LACL = Lake Clark National Park and Preserve; KATM = Katmai National Park and Preserve.

[B] DO concentrations >10 $mg \cdot L^{-1}$ at depths of 190 m have been recorded in Lake Clark (Wilkens, 2002).

Table A.5. Quality assurance metrics for field duplicates of filter-passing water collected at a subset of lakes and depths.

Park [A]	Lake name	Metric [B]	Depth (m)	THg ($ng \cdot L^{-1}$)	MeHg ($ng \cdot L^{-1}$)	DOC ($mg \cdot L^{-1}$)	SO_4^{2-} ($mg \cdot L^{-1}$)
LACL	Kijik	Mean	12	0.171	0.012	0.558	9.741
LACL	Kijik	Difference (abs.)	12	0.012	0.010	0.002	0.059
LACL	Clark	Mean	10	0.206	0.003	[C]	[C]
LACL	Clark	Difference (abs.)	10	0.032	0.006	[C]	[C]
KATM	Hammersly	Mean	7.5	0.239	0.004	0.618	2.913
KATM	Hammersly	Difference (abs.)	7.5	0.033	0.003	0.004	0.965
[D]	[D]	Mean blank	[D]	0.063	0.004	0.161	0.015
[D]	[D]	Detection limit [E]	[D]	0.040	0.010	0.200	0.017

[A] LACL = Lake Clark National Park and Preserve; KATM = Katmai National Park and Preserve.

[B] Metrics included mean, absolute difference, and percent difference of two duplicate samples.

[C] Field duplicates were not collected for these analytes.

[D] Does not apply.

[E] Method detection limits (MDL) are reported except for SO_4^{2-}, which had no established MDL and was therefore calculated as 3 x standard deviation of the mean blank value.

Table A.6. Total mercury (THg) and methylmercury (MeHg) concentrations measured as ng·g^{-1} dry weight in size-sieved plankton. The percentage of THg that is MeHg is reported for each size fraction. Bulk MeHg concentrations and bioaccumulation factors (BAFs) are calculated once per lake.

Park [A]	Lake name	Size (µm)	Mass (g)	THg (ng·g^{-1})	MeHg (ng·g^{-1})	Percent MeHg (%)	Bulk MeHg (ng·g^{-1}) [B]	BAF (log(L·kg^{-1})) [C]
LACL	Telaquana	>500	0.51	20.00	9.18	45.90	B	C
LACL	Telaquana	243-500	0.20	16.37	9.64	58.92	B	C
LACL	Telaquana	118-243	0.07	14.01	5.89	42.05	B	C
LACL	Telaquana	63-118	0.04	10.31	2.39	23.20	8.67	5.34
LACL	Turquoise	>500	0.13	16.64	8.22	49.40	B	C
LACL	Turquoise	243-500	0.24	36.50	8.16	22.35	B	C
LACL	Turquoise	118-243	0.05	23.83	11.62	48.75	B	C
LACL	Turquoise	63-118	0.01	22.88	2.28	9.97	8.35	5.89
LACL	Snipe	>500	0.50	35.44	23.01	64.92	B	C
LACL	Snipe	243-500	0.13	34.49	24.66	71.50	B	C
LACL	Snipe	118-243	0.09	22.35	11.82	52.90	B	C
LACL	Snipe	63-118	0.06	12.58	6.36	50.57	20.62	5.39
LACL	Lachbuna	>500	0.15	41.51	21.75	52.40	B	C
LACL	Lachbuna	243-500	0.26	36.77	18.71	50.89	B	C
LACL	Lachbuna	118-243	0.03	21.00	9.87	47.02	B	C
LACL	Lachbuna	63-118	0.01	13.87	0.55	4.00	18.82	5.03
LACL	Crescent	>500	0.08	33.76	23.01	68.16	B	C
LACL	Crescent	243-500	0.29	32.71	23.47	71.76	B	C
LACL	Crescent	118-243	0.01	157.55	12.49	7.93	B	C
LACL	Crescent	63-118	0.02	146.00	1.94	1.33	22.05	5.40
LACL	Kijik	>500	1.14	37.80	22.49	59.48	B	C
LACL	Kijik	243-500	0.05	20.79	9.56	45.99	B	C
LACL	Kijik	118-243	0.06	20.55	8.21	39.96	B	C
LACL	Kijik	63-118	0.03	17.38	3.95	22.71	20.83	5.88
LACL	Kontrashibuna	>500	1.77	55.78	23.97	42.98	B	C
LACL	Kontrashibuna	243-500	0.22	46.42	29.33	63.18	B	C
LACL	Kontrashibuna	118-243	0.06	24.82	13.08	52.71	B	C
LACL	Kontrashibuna	63-118	0.06	16.67	3.63	21.81	23.67	6.24
LACL	Clark	>500	1.33	45.74	25.43	55.61	B	C
LACL	Clark	243-500	0.40	29.08	19.35	66.52	B	C
LACL	Clark	118-243	0.08	26.48	11.15	42.10	B	C
LACL	Clark	63-118	0.07	12.31	5.21	42.32	22.79	6.19
KATM	Kukaklek	>500	0.23	67.28	30.02	44.61	B	C
KATM	Kukaklek	243-500	0.26	48.05	16.93	35.24	B	C
KATM	Kukaklek	118-243	0.05	24.85	8.27	33.30	B	C
KATM	Kukaklek	63-118	0.02	25.14	7.93	31.56	21.04	6.26

Park [A]	Lake name	Size (µm)	Mass (g)	THg (ng·g^{-1})	MeHg (ng·g^{-1})	Percent MeHg (%)	Bulk MeHg (ng·g^{-1}) [B]	BAF (log(L·kg^{-1})) [C]
KATM	Nonvianuk	>500	0.06	53.39	29.84	55.89	[B]	[C]
KATM	Nonvianuk	243-500	0.12	40.26	22.05	54.77	[B]	[C]
KATM	Nonvianuk	118-243	0.10	24.28	8.71	35.88	[B]	[C]
KATM	Nonvianuk	63-118	0.01	28.14	9.11	32.39	18.59	5.98
KATM	Kulik	>500	0.10	66.55	39.48	59.33	[B]	[C]
KATM	Kulik	243-500	0.15	52.64	29.41	55.87	[B]	[C]
KATM	Kulik	118-243	0.01	55.49	14.60	26.31	[B]	[C]
KATM	Kulik	63-118	0.01	72.20	12.16	16.84	31.70	6.90
KATM	Hammersly	>500	0.53	96.42	40.57	42.07	[B]	[C]
KATM	Hammersly	243-500	0.13	57.22	23.10	40.37	[B]	[C]
KATM	Hammersly	118-243	<0.01	69.20	17.04	24.62	[B]	[C]
KATM	Hammersly	63-118	<0.01	[D]	10.16 [D]	[D]	36.92	6.44
KATM	Grosvenor	>500	1.85	121.36	61.93	51.03	[B]	[C]
KATM	Grosvenor	243-500	0.14	53.70	36.54	68.04	[B]	[C]
KATM	Grosvenor	118-243	0.05	36.26	21.64	59.69	[B]	[C]
KATM	Grosvenor	63-118	0.01	29.84	14.79	49.55	59.01	5.92
KATM	Brooks	>500	0.55	76.01	51.46	67.71	[B]	[C]
KATM	Brooks	243-500	0.80	46.33	29.31	63.25	[B]	[C]
KATM	Brooks	118-243	0.17	17.07	7.58	44.42	[B]	[C]
KATM	Brooks	63-118	0.06	17.62	7.77	44.08	33.96	5.75

[A] LACL = Lake Clark National Park and Preserve; KATM = Katmai National Park and Preserve.

[B] Bulk MeHg concentrations pertain to a single bulk sample per lake, including all size fractions (63 - >500 µm).

[C] Like bulk MeHg concentrations, BAF was calculated once per lake, but only using the 63 - 118 µm size fraction.

[D] The amount collected for this size fraction was too small to enable Hg analysis, so a value was estimated from a linear regression using data from the five other KATM lakes: $y = 0.0762x + 5.364$ ($R^2 = 0.723$, $F = 46.970$, $df = 1$, $p < 0.001$), where y = MeHg content in ng g^{-1} and x = the lower value in the size fraction range (i.e., 63 µm).

Table A.7. Field and lab measurements for 158 lake trout sampled from 14 lakes from 2011 to 2016. Field measurements include the coordinates where fish were sampled in decimal degrees, as well as their total length, weight, age, and sex. Lab measurements include total mercury (HgT ng g^{-1} dry weight), percent moisture, nitrogen and carbon stable isotope ratios ($\delta^{15}N$, $\delta^{13}C$, and $\delta^{13}C_{lipid\text{-}free}$), C:N ratio, and percent lipid.

Park [A]	Lake name	Sample ID	Sample date [B]	Latitude (DD) [C]	Longitude (DD) [C]	Length (mm)	Weight (kg) [D]	Age (yrs) [E]	Sex [F]	HgT (ng g^{-1})	Moisture (%)	$\delta^{15}N$ (‰)	$\delta^{13}C$ (‰)	$\delta^{13}C_{l\text{-}f}$ (‰) [G]	Molar C:N	Lipid (%) [H]
LACL	Telaquana	11LATR0003	2011-08-12	60.95140	-153.76580	581	1.29	16	U	661	80.2	11.12	-22.60	-22.82	3.67	10.62
LACL	Telaquana	11LATR0004	2011-08-12	60.95140	-153.76580	615	1.69	17	U	344	78.2	12.45	-19.93	-19.98	3.77	12.32
LACL	Telaquana	11LATR0005	2011-08-12	60.95140	-153.76580	525	1.04	20	U	740	81.4	14.91	-22.22	-22.40	3.70	10.99
LACL	Telaquana	11LATR0007	2011-08-12	60.95140	-153.76580	574	1.24	15	U	983	79.3	11.74	-25.13	-25.17	3.78	12.45
LACL	Telaquana	11LATR0008	2011-08-12	60.95140	-153.76580	655	2.46	16	U	369	76.4	14.86	-19.79	-19.69	3.85	13.72
LACL	Telaquana	11LATR0009	2011-08-12	60.95140	-153.76580	486	0.63	12	U	1403	81.8	11.99	-25.41	-25.59	3.70	11.12
LACL	Telaquana	11LATR0010	2011-08-12	60.95140	-153.76580	560	1.24	15	U	476	79.9	11.61	-23.04	-23.20	3.71	11.23
LACL	Telaquana	11LATR0013	2011-08-12	60.95140	-153.76580	551	1.27	10	U	248	77.9	13.99	-21.55	-21.53	3.81	13.03
LACL	Telaquana	11LATR0015	2011-08-12	60.95140	-153.76580	681	2.29	17	U	1254	78.5	12.40	-23.69	-23.77	3.75	11.99
LACL	Telaquana	11LATR0016	2011-08-12	60.95140	-153.76580	530	1.10	13	U	782	79.8	11.60	-24.91	-24.95	3.78	12.45
LACL	Turquoise	MSC479AA	2015-09-06	60.77814	-153.98682	426	0.70	12	M	353	73.6	11.25	-27.37	-26.14	4.68	25.48
LACL	Turquoise	MSC480AA	2015-09-06	60.77814	-153.98682	457	0.82	26	M	555	78.7	10.16	-23.44	-23.34	3.86	13.75
LACL	Turquoise	MSC481AA	2015-09-06	60.77814	-153.98682	429	0.72	18	F	551	78.6	10.91	-24.08	-23.90	3.91	14.65
LACL	Turquoise	MSC482AA	2015-09-06	60.77814	-153.98682	454	0.76	18	F	678	77.5	11.09	-26.94	-25.88	4.54	23.64
LACL	Turquoise	MSC483AA	2015-09-06	60.77814	-153.98682	422	0.60	21	U	737	80.2	10.81	-24.86	-25.03	3.71	11.19
LACL	Turquoise	MSC484AA	2015-09-06	60.77814	-153.98682	435	0.64	16	F	559	78.6	10.60	-22.28	-21.95	4.00	16.07
LACL	Turquoise	MSC485AA	2015-09-06	60.77814	-153.98682	391	0.50	7	U	191	78.3	10.53	-25.42	-25.01	4.06	16.96
LACL	Turquoise	MSC486AA	2015-09-06	60.77814	-153.98682	424	0.52	18	U	914	80.4	10.80	-22.52	-22.68	3.71	11.24
LACL	Turquoise	MSC487AA	2015-09-06	60.77814	-153.98682	395	0.50	15	M	483	77.6	11.19	-26.85	-25.90	4.45	22.52
LACL	Turquoise	MSC488AA	2015-09-06	60.77814	-153.98682	439	0.66	17	F	746	79.3	10.15	-22.84	-22.89	3.77	12.37
LACL	Turquoise	MSC489AA	2015-09-06	60.77814	-153.98682	527	1.16	14	F	512	76.8	10.59	-24.81	-24.46	4.02	16.36
LACL	Snipe	MSC312AA	2015-06-15	60.62195	-154.31197	395	0.46	7	M	678	76.3	10.73	-24.62	-23.93	4.25	19.83
LACL	Snipe	MSC311AA	2015-06-15	60.62195	-154.31197	462	0.73	9	F	861	79.2	10.74	-23.26	-23.35	3.75	11.96
LACL	Snipe	MSC306AA	2015-06-15	60.62195	-154.31197	458	0.80	11	M	1030	76.7	11.15	-23.51	-23.41	3.86	13.76
LACL	Snipe	MSC309AA	2015-06-15	60.62195	-154.31197	504	0.95	13	M	1050	80.1	10.34	-23.63	-23.61	3.81	12.96

Park [A]	Lake name	Sample ID	Sample date [B]	Latitude (DD) [C]	Longitude (DD) [C]	Length (mm)	Weight (kg) [D]	Age (yrs) [E]	Sex [F]	HgT (ng g^{-1})	Moisture (%)	$\delta^{15}N$ (‰)	$\delta^{13}C$ (‰)	$\delta^{13}C_{l-f}$ (‰) [G]	Molar C:N	Lipid (%) [H]
LACL	Snipe	MSC308AA	2015-06-15	60.62195	-154.31197	535	1.30	9	M	893	72.0	10.35	-23.93	-22.82	4.58	24.25
LACL	Snipe	MSC305AA	2015-06-15	60.62195	-154.31197	386	0.50	9	M	779	78.8	11.19	-23.89	-23.98	3.75	11.98
LACL	Snipe	MSC307AA	2015-06-15	60.62195	-154.31197	506	0.96	9	F	1200	81.1	10.79	-22.82	-22.91	3.74	11.86
LACL	Snipe	MSC303AA	2015-06-15	60.62195	-154.31197	453	0.66	10	M	843	75.4	11.28	-24.83	-24.29	4.15	18.33
LACL	Snipe	MSC310AA	2015-06-15	60.62195	-154.31197	469	0.84	12	M	817	78.2	11.31	-23.23	-22.61	4.20	19.13
LACL	Snipe	MSC304AA	2015-06-15	60.62195	-154.31197	479	0.94	10	M	916	76.9	10.98	-23.29	-23.10	3.92	14.73
LACL	Lachbuna	MSC302Z	2013-06-26	60.49612	-153.99748	410	0.80	9	F	412	75.5	13.30	-25.98	-25.45	4.13	18.12
LACL	Lachbuna	MSC298Z	2013-06-27	60.49612	-153.99748	384	0.44	7	M	349	76.4	11.58	-22.88	-22.66	3.93	14.97
LACL	Lachbuna	MSC313Z	2013-06-27	60.49612	-153.99748	435	0.62	14	F	660	79.1	10.23	-27.83	-28.07	3.66	10.41
LACL	Lachbuna	MSC304Z	2013-06-27	60.49612	-153.99748	486	0.82	23	M	260	80.6	9.47	-27.18	-27.40	3.67	10.62
LACL	Lachbuna	MSC300Z	2013-06-27	60.49612	-153.99748	518	1.06	15	F	822	79.2	11.55	-23.78	-23.81	3.78	12.56
LACL	Lachbuna	MSC310Z	2013-06-27	60.49612	-153.99748	472	1.00	12	M	678	80.0	10.78	-26.90	-27.31	3.57	8.79
LACL	Lachbuna	MSC311Z	2013-06-27	60.49612	-153.99748	480	1.05	15	F	754	78.9	9.06	-25.96	-26.23	3.65	10.12
LACL	Lachbuna	MSC307Z	2013-06-27	60.49612	-153.99748	463	0.95	19	M	985	78.7	10.07	-25.62	-25.65	3.78	12.55
LACL	Lachbuna	MSC308Z	2013-06-27	60.49612	-153.99748	444	0.85	20	F	909	79.2	11.22	-22.35	-22.63	3.65	10.09
LACL	Lachbuna	MSC303Z	2013-06-27	60.49612	-153.99748	476	1.02	20	M	833	77.3	9.08	-28.23	-28.26	3.78	12.50
LACL	Crescent	MSC323AA	2015-07-09	60.37442	-152.90033	628	2.36	15	M	586	74.3	14.49	-21.77	-20.75	4.51	23.28
LACL	Crescent	MSC331AA	2015-07-09	60.37442	-152.90033	531	1.21	17	F	1020	76.0	13.56	-23.88	-23.22	4.23	19.47
LACL	Crescent	MSC325AA	2015-07-09	60.37442	-152.90033	514	1.07	15	M	481	76.4	13.83	-23.20	-22.50	4.25	19.82
LACL	Crescent	MSC326AA	2015-07-09	60.37442	-152.90033	458	0.87	23	M	702	74.7	12.81	-24.36	-22.83	4.97	28.78
LACL	Crescent	MSC328AA	2015-07-10	60.37639	-152.94149	653	3.22	23	M	474	71.7	15.45	-22.04	-19.69	5.95	37.95
LACL	Crescent	MSC329AA	2015-07-10	60.37639	-152.94149	588	1.97	20	U	598	74.7	13.64	-22.45	-21.31	4.61	24.57
LACL	Crescent	MSC330AA	2015-07-10	60.37639	-152.94149	497	1.07	18	F	1200	76.7	12.33	-24.19	-23.55	4.22	19.33
LACL	Crescent	MSC127AA	2015-07-10	60.37639	-152.94149	453	1.03	12	M	1070	76.5	13.59	-24.40	-23.44	4.46	22.62
LACL	Crescent	MSC128AA	2015-07-10	60.37639	-152.94149	370	0.42	10	M	710	77.3	12.13	-28.95	-27.92	4.51	23.34
LACL	Crescent	MSC324AA	2015-07-10	60.37639	-152.94149	436	0.71	12	F	1120	75.7	12.08	-25.86	-25.20	4.23	19.52
LACL	Kijik	MSC306Z	2013-06-26	60.28483	-154.34276	415	0.70	9	M	340	76.5	12.89	-25.05	-25.11	3.76	12.17
LACL	Kijik	MSC309Z	2013-06-26	60.28483	-154.34276	510	1.20	15	M	566	79.7	13.15	-22.73	-22.78	3.77	12.37
LACL	Kijik	MSC314Z	2013-06-26	60.28483	-154.34276	408	0.50	10	M	1026	77.4	13.04	-29.82	-29.03	4.33	20.90

Park [A]	Lake name	Sample ID	Sample date [B]	Latitude (DD) [C]	Longitude (DD) [C]	Length (mm)	Weight (kg) [D]	Age (yrs) [E]	Sex [F]	HgT (ng g^{-1})	Moisture (%)	δ^{15}N (‰)	δ^{13}C (‰)	$\delta^{13}C_{l-f}$ (‰) [G]	Molar C:N	Lipid (%) [H]
LACL	Kijik	MSC305Z	2013-06-26	60.28483	-154.34276	445	0.86	14	M	860	75.5	14.57	-25.26	-24.44	4.35	21.17
LACL	Kijik	MSC296Z	2013-06-26	60.28483	-154.34276	456	0.68	15	F	835	78.8	14.01	-24.35	-24.21	3.88	14.22
LACL	Kijik	MSC315Z	2013-06-26	60.28483	-154.34276	468	0.94	12	F	416	75.9	13.98	-24.41	-23.46	4.45	22.53
LACL	Kijik	MSC299Z	2013-06-26	60.28483	-154.34276	436	0.78	11	F	654	78.6	13.87	-25.28	-25.36	3.76	12.08
LACL	Kijik	MSC297Z	2013-06-26	60.28483	-154.34276	458	0.90	12	M	726	77.4	13.52	-27.06	-26.76	3.99	15.85
LACL	Kijik	MSC312Z	2013-06-26	60.28483	-154.34276	447	0.96	13	F	297	76.5	13.82	-25.06	-24.07	4.48	22.90
LACL	Kijik	MSC301Z	2013-06-26	60.28483	-154.34276	397	0.58	9	M	399	77.9	13.26	-27.60	-27.45	3.89	14.31
LACL	Kontrashibuna	11LATR0033	2011-06-27	60.18010	-154.18280	363	0.40	7	U	151	76.3	9.70	-15.78	-15.73	3.83	13.33
LACL	Kontrashibuna	11LATR0034	2011-06-11	60.18010	-154.18280	420	0.65	12	U	1671	77.8	10.93	-20.55	-20.39	3.90	14.47
LACL	Kontrashibuna	11LATR0035	2011-08-24	60.18010	-154.18280	440	0.62	14	U	1630	77.5	10.78	-22.14	-22.18	3.78	12.43
LACL	Kontrashibuna	11LATR0037	2011-06-27	60.18010	-154.18280	394	0.51	8	U	1066	77.4	10.92	-18.99	-18.89	3.86	13.75
LACL	Kontrashibuna	11LATR0039	2011-06-11	60.18010	-154.18280	420	0.67	10	U	372	76.4	10.24	-17.29	-16.70	4.18	18.86
LACL	Kontrashibuna	11LATR0041	2011-09-07	60.18010	-154.18280	458	0.72	11	U	1232	77.4	11.35	-20.80	-20.44	4.02	16.40
LACL	Kontrashibuna	11LATR0044	2011-08-24	60.18010	-154.18280	446	0.85	18	U	577	76.3	10.63	-17.16	-16.64	4.13	18.07
LACL	Kontrashibuna	11LATR0045	2011-08-24	60.18010	-154.18280	461	0.84	15	U	1145	78.2	10.37	-22.66	-22.62	3.82	13.16
LACL	Kontrashibuna	13LATR0024	2012-08-11	60.17989	-154.23845	449	0.73	13	F	926	76.6	9.50	-21.60	-21.44	3.90	14.48
LACL	Kontrashibuna	13LATR0029	2012-08-11	60.17989	-154.23845	434	0.83	15	M	764	76.5	10.59	-18.41	-18.19	3.93	15.03
LACL	Clark	11LATR0017	2011-08-28	60.01874	-154.75743	598	1.55	12	U	1465	76.9	12.15	-26.17	-25.64	4.14	18.19
LACL	Clark	11LATR0018	2011-08-28	60.01874	-154.75743	760	4.16	13	U	1223	75.3	11.56	-20.26	-19.35	4.42	22.10
LACL	Clark	11LATR0019	2011-08-28	60.01874	-154.75743	614	1.59	16	U	1935	77.5	11.87	-26.09	-26.11	3.79	12.65
LACL	Clark	11LATR0020	2011-08-28	60.01874	-154.75743	623	1.87	13	U	1076	77.9	12.01	-23.80	-23.65	3.89	14.37
LACL	Clark	11LATR0021	2011-08-28	60.01874	-154.75743	490	0.83	11	U	1675	79.5	11.61	-27.34	-27.27	3.84	13.50
LACL	Clark	11LATR0022	2011-08-28	60.01874	-154.75743	500	0.89	12	U	1814	78.3	11.62	-26.93	-27.01	3.76	12.08
LACL	Clark	11LATR0023	2011-08-28	60.01874	-154.75743	610	1.99	12	U	1361	75.8	11.48	-22.30	-21.63	4.24	19.60
LACL	Clark	11LATR0024	2011-08-28	60.01874	-154.75743	507	0.91	13	U	1478	78.8	11.18	-27.13	-27.11	3.81	13.02
LACL	Clark	11LATR0025	2011-08-28	60.01874	-154.75743	616	2.09	17	U	1367	76.0	12.19	-18.12	-18.00	3.87	14.02
LACL	Clark	11LATR0026	2011-08-28	60.01874	-154.75743	578	1.54	15	U	2714	74.5	12.41	-25.74	-25.10	4.21	19.29
LACL	Clark	11LATR0027	2011-08-28	60.01874	-154.75743	591	1.59	12	U	1294	77.3	12.09	-23.28	-23.22	3.84	13.43
LACL	Clark	11LATR0028	2011-08-28	60.01874	-154.75743	566	1.07	16	U	2206	79.5	11.65	-26.90	-27.02	3.73	11.59

Park [A]	Lake name	Sample ID	Sample date [B]	Latitude (DD) [C]	Longitude (DD) [C]	Length (mm)	Weight (kg) [D]	Age (yrs) [E]	Sex [F]	HgT (ng g^{-1})	Moisture (%)	δ^{15}N (‰)	δ^{13}C (‰)	$\delta^{13}C_{l-f}$ (‰) [G]	Molar C:N	Lipid (%) [H]
LACL	Clark	11LATR0029	2011-08-28	60.01874	-154.75743	581	1.51	13	U	2142	76.6	12.29	-24.64	-24.38	3.96	15.45
LACL	Clark	11LATR0030	2011-08-28	60.01874	-154.75743	561	1.37	13	U	2387	77.9	11.79	-25.27	-25.25	3.81	13.00
LACL	Clark	11LATR0031	2011-08-28	60.01874	-154.75743	478	0.85	10	U	1066	76.0	11.13	-27.28	-26.93	4.02	16.34
LACL	Clark	13LATR0001	2012-09-09	60.01874	-154.75743	546	1.41	18	M	1618	77.2	11.86	-18.05	-17.97	3.85	13.62
LACL	Clark	13LATR0002	2012-09-09	60.01874	-154.75743	635	1.58	21	M	3039	81.5	11.89	-21.61	-21.81	3.68	10.79
LACL	Clark	13LATR0003	2012-09-09	60.01874	-154.75743	660	2.72	17	F	2173	76.2	12.15	-26.29	-25.44	4.37	21.49
LACL	Clark	13LATR0004	2012-09-09	60.01874	-154.75743	576	1.59	16	F	2694	76.7	12.47	-27.49	-26.50	4.48	22.92
LACL	Clark	13LATR0005	2012-09-09	60.01874	-154.75743	508	1.15	10	F	1094	77.1	11.39	-27.74	-27.07	4.24	19.70
LACL	Clark	13LATR0006	2012-09-09	60.01874	-154.75743	526	1.30	12	F	1422	75.9	11.68	-26.31	-25.69	4.20	19.14
LACL	Clark	13LATR0007	2012-09-09	60.01874	-154.75743	506	1.23	11	M	1405	77.5	12.70	-24.61	-24.20	4.06	16.94
LACL	Clark	13LATR0023	2012-09-09	60.01874	-154.75743	596	1.97	11	F	1181	76.6	11.97	-22.01	-21.83	3.91	14.58
LACL	Clark	13LATR0025	2012-09-09	60.01874	-154.75743	514	1.06	14	F	1510	76.9	11.42	-26.54	-26.36	3.91	14.63
LACL	Clark	13LATR0026	2012-09-09	60.01874	-154.75743	535	1.24	13	F	1255	76.1	11.06	-27.80	-27.13	4.23	19.57
LACL	Clark	13LATR0027	2012-09-09	60.01874	-154.75743	542	1.28	16	F	1486	77.9	12.56	-24.36	-24.12	3.94	15.19
LACL	Clark	13LATR0028	2012-09-09	60.01874	-154.75743	558	1.80	13	M	1595	75.8	12.55	-22.34	-21.84	4.12	17.87
KATM	Kukaklek	MSC511AC	2016-06-14	59.19012	-155.18902	484	0.95	13	M	640	77.4	15.62	-23.46	-22.47	4.48	22.92
KATM	Kukaklek	MSC512AC	2016-06-14	59.19012	-155.18902	558	1.70	11	M	672	69.2	14.85	-28.06	-25.42	6.40	41.31
KATM	Kukaklek	MSC513AC	2016-06-14	59.19012	-155.18902	526	1.30	11	F	701	74.9	14.98	-25.79	-24.14	5.09	30.06
KATM	Kukaklek	MSC514AC	2016-06-14	59.19012	-155.18902	548	1.31	14	M	761	73.6	15.70	-24.78	-22.85	5.40	33.12
KATM	Kukaklek	MSC515AC	2016-06-14	59.19012	-155.18902	496	1.02	17	M	821	78.0	15.76	-23.60	-22.86	4.29	20.36
KATM	Kukaklek	MSC516AC	2016-06-14	59.19012	-155.18902	500	1.06	10	M	649	77.6	15.23	-25.15	-24.34	4.34	21.10
KATM	Kukaklek	MSC517AC	2016-06-14	59.19012	-155.18902	462	0.75	8	M	677	78.5	16.14	-22.52	-22.29	3.94	15.12
KATM	Kukaklek	MSC518AC	2016-06-14	59.19012	-155.18902	483	1.01	13	M	462	76.2	15.38	-23.49	-22.22	4.72	25.96
KATM	Kukaklek	MSC519AC	2016-06-14	59.19012	-155.18902	503	1.14	10	M	723	73.6	14.98	-26.67	-24.92	5.20	31.20
KATM	Kukaklek	MSC520AC	2016-06-14	59.19012	-155.18902	506	1.24	7	F	677	76.1	15.90	-23.51	-22.26	4.71	25.76
KATM	Nonvianuk	MSC521AC	2016-06-23	58.98538	-155.12607	631	1.95	15	M	603	76.0	13.16	-23.67	-22.45	4.68	25.38
KATM	Nonvianuk	MSC522AC	2016-06-23	58.98538	-155.12607	516	1.14	8	F	470	75.2	12.28	-24.90	-23.99	4.42	22.15
KATM	Nonvianuk	MSC523AC	2016-06-23	58.98538	-155.12607	644	1.54	10	M	593	73.1	12.39	-26.08	-24.45	5.06	29.77
KATM	Nonvianuk	MSC524AC	2016-06-23	58.98538	-155.12607	524	1.40	10	F	663	74.9	12.92	-25.67	-24.52	4.62	24.73

Park [A]	Lake name	Sample ID	Sample date [B]	Latitude (DD) [C]	Longitude (DD) [C]	Length (mm)	Weight (kg) [D]	Age (yrs) [E]	Sex [F]	HgT (ng g^{-1})	Moisture (%)	δ^{15}N (‰)	δ^{13}C (‰)	$\delta^{13}C_{l-f}$ (‰) [G]	Molar C:N	Lipid (%) [H]
KATM	Nonvianuk	MSC525AC	2016-06-28	58.98538	-155.12607	506	1.15	9	F	729	74.0	12.98	-24.84	-23.72	4.59	24.30
KATM	Nonvianuk	MSC526AC	2016-06-28	58.98538	-155.12607	604	1.96	12	M	825	73.9	13.07	-25.72	-24.21	4.95	28.51
KATM	Nonvianuk	MSC527AC	2016-06-28	58.98538	-155.12607	546	1.09	13	F	2563	78.8	11.14	-25.44	-25.24	3.92	14.81
KATM	Nonvianuk	MSC528AC	2016-06-28	58.98538	-155.12607	577	1.53	11	F	672	75.5	12.75	-24.35	-23.25	4.57	24.07
KATM	Nonvianuk	MSC529AC	2016-06-28	58.98538	-155.12607	548	1.32	9	F	700	74.2	12.55	-25.14	-23.89	4.70	25.64
KATM	Nonvianuk	MSC530AC	2016-06-28	58.98538	-155.12607	506	1.05	15	M	1122	76.4	13.45	-24.52	-23.66	4.37	21.51
KATM	Kulik	MSC333AA	2015-08-27	58.93485	-154.91367	529	1.24	17	F	1500	78.8	13.20	-23.03	-22.70	4.00	16.12
KATM	Kulik	MSC134AA	2015-08-27	58.93485	-154.91367	853	5.80	24	M	1690	76.8	13.48	-16.61	-16.12	4.11	17.78
KATM	Kulik	MSC334AA	2015-08-28	58.93378	-154.91361	483	1.07	17	M	1760	79.8	12.85	-21.34	-21.10	3.95	15.29
KATM	Kulik	MSC197AC	2016-06-22	58.98965	-155.06236	606	2.14	15	M	641	72.0	12.74	-26.26	-24.07	5.73	36.11
KATM	Kulik	MSC196AC	2016-06-22	58.98965	-155.06236	610	2.19	15	M	828	72.9	13.03	-25.24	-23.62	5.06	29.68
KATM	Kulik	MSC504AC	2016-06-22	58.98965	-155.06236	546	1.35	14	M	1409	74.4	11.73	-25.70	-24.31	4.83	27.24
KATM	Kulik	MSC503AC	2016-06-21	58.89552	-154.80120	574	0.93	15	F	2164	79.6	11.41	-22.72	-22.62	3.86	13.80
KATM	Kulik	MSC502AC	2016-06-22	58.98965	-155.06236	586	1.58	13	F	761	77.2	13.27	-24.18	-23.13	4.53	23.62
KATM	Kulik	MSC501AC	2016-06-22	58.98337	-155.09557	564	1.50	14	M	666	75.5	12.91	-23.75	-22.63	4.59	24.26
KATM	Kulik	MSC500AC	2016-06-22	58.98337	-155.09557	518	0.99	18	M	2863	80.4	12.01	-25.99	-25.72	3.97	15.53
KATM	Hammersly	MSC313AA	2015-06-23	58.86274	-155.14569	543	1.33	22	F	1560	78.3	11.20	-22.49	-21.64	4.37	21.51
KATM	Hammersly	MSC315AA	2015-06-23	58.86274	-155.14569	472	0.96	12	F	1750	76.0	9.83	-22.57	-22.07	4.12	17.89
KATM	Hammersly	MSC314AA	2015-06-23	58.86274	-155.14569	437	0.75	10	F	1460	76.5	10.19	-25.46	-24.64	4.35	21.17
KATM	Hammersly	MSC316AA	2015-06-23	58.86274	-155.14569	454	0.91	12	F	1780	72.5	9.62	-25.60	-24.12	4.92	28.19
KATM	Hammersly	MSC318AA	2015-06-23	58.86274	-155.14569	498	0.96	20	M	2930	77.4	9.82	-24.02	-23.57	4.09	17.40
KATM	Hammersly	MSC322AA	2015-06-23	58.86274	-155.14569	402	0.63	11	M	1400	76.6	9.73	-23.24	-22.49	4.30	20.49
KATM	Hammersly	MSC319AA	2015-06-23	58.86274	-155.14569	462	0.99	11	F	1870	73.6	9.91	-24.37	-23.49	4.40	21.85
KATM	Hammersly	MSC317AA	2015-06-23	58.86274	-155.14569	453	0.92	10	F	1950	74.0	9.81	-25.56	-24.35	4.67	25.27
KATM	Hammersly	MSC320AA	2015-06-23	58.86274	-155.14569	490	1.05	11	F	1800	71.9	9.77	-26.23	-24.19	5.55	34.48
KATM	Hammersly	MSC321AA	2015-06-23	58.86274	-155.14569	491	1.06	19	F	2920	75.6	10.27	-25.04	-24.10	4.44	22.43
KATM	Grosvenor	MSC337AA	2015-09-10	58.69509	-155.22717	487	0.95	15	M	2260	77.2	14.16	-25.30	-24.29	4.50	23.21
KATM	Grosvenor	MSC338AA	2015-09-10	58.69509	-155.22717	474	1.04	16	F	2100	76.7	14.21	-25.27	-24.55	4.28	20.20
KATM	Grosvenor	MSC336AA	2015-09-10	58.69509	-155.22717	427	0.66	17	M	2530	78.3	14.55	-25.59	-25.39	3.92	14.86

Park [A]	Lake name	Sample ID	Sample date [B]	Latitude (DD) [C]	Longitude (DD) [C]	Length (mm)	Weight (kg) [D]	Age (yrs) [E]	Sex [F]	HgT (ng g^{-1})	Moisture (%)	$\delta^{15}N$ (‰)	$\delta^{13}C$ (‰)	$\delta^{13}C_{l-f}$ (‰) [G]	Molar C:N	Lipid (%) [H]
KATM	Grosvenor	MSC335AA	2015-09-10	58.69509	-155.22717	482	0.93	10	M	1860	76.5	14.56	-29.14	-28.15	4.48	22.94
KATM	Grosvenor	MSC505AC	2016-06-19	58.71878	-155.49506	542	1.55	15	F	1745	75.7	13.81	-28.63	-27.32	4.76	26.36
KATM	Grosvenor	MSC506AC	2016-06-19	58.71878	-155.49506	634	2.30	22	F	2289	76.9	14.96	-29.99	-29.01	4.48	22.87
KATM	Grosvenor	MSC507AC	2016-06-19	58.71878	-155.49506	504	1.08	15	M	2634	76.8	14.82	-23.41	-22.77	4.22	19.38
KATM	Grosvenor	MSC508AC	2016-06-19	58.71878	-155.49506	620	2.30	20	M	1957	77.7	15.84	-28.60	-27.89	4.26	20.00
KATM	Grosvenor	MSC509AC	2016-06-19	58.71878	-155.49506	514	1.03	13	M	2573	79.2	14.74	-27.19	-26.39	4.33	20.91
KATM	Grosvenor	MSC510AC	2016-06-19	58.71878	-155.49506	490	0.95	10	F	1341	84.9	14.14	-27.98	-26.91	4.55	23.82
KATM	Brooks	MSC316Z	2011-06-18	58.47310	-156.03790	550	1.45	20	F	3046	78.2	13.78	-25.21	-25.21	3.80	12.83
KATM	Brooks	MSC319Z	2011-06-18	58.47310	-156.03790	525	1.23	17	M	1549	73.0	14.16	-26.96	-25.58	4.83	27.15
KATM	Brooks	MSC322Z	2011-06-19	58.47310	-156.03790	561	1.41	19	U	2508	76.3	13.81	-24.44	-23.98	4.09	17.52
KATM	Brooks	MSC317Z	2011-06-19	58.47310	-156.03790	528	1.17	14	F	2517	76.6	14.24	-25.85	-25.74	3.87	13.91
KATM	Brooks	MSC324Z	2011-06-19	58.47310	-156.03790	529	1.33	24	U	2379	75.8	14.14	-26.78	-25.99	4.32	20.81
KATM	Brooks	MSC323Z	2011-06-19	58.47310	-156.03790	534	1.18	19	F	1949	75.4	12.96	-27.22	-26.02	4.66	25.13
KATM	Brooks	MSC325Z	2011-06-19	58.47310	-156.03790	499	1.15	19	M	1534	72.9	13.45	-26.56	-25.33	4.69	25.50
KATM	Brooks	MSC321Z	2011-06-19	58.47310	-156.03790	525	1.19	19	F	2020	74.3	13.52	-28.00	-26.54	4.91	28.04
KATM	Brooks	MSC320Z	2011-06-19	58.47310	-156.03790	550	1.32	21	M	1910	76.1	9.29	-29.92	-29.56	4.02	16.41
KATM	Brooks	MSC318Z	2011-06-19	58.47310	-156.03790	485	1.01	17	M	2593	77.0	14.24	-26.74	-25.95	4.32	20.84

[A] LACL = Lake Clark National Park and Preserve; KATM = Katmai National Park and Preserve.

[B] For Snipe Lake, the sample date spanned 2 days (2015-06-15 – 2015-06-16); for Turquoise Lake, it spanned 3 days (2015-09-06 – 2015-09-08).

[C] Coordinates for 4 lake trout at Grosvenor Lake and 6 lake trout at Crescent Lake are averages representing multiple locations.

[D] Weight (W) was estimated from length (L) for 5 Lachbuna lake trout using a relationship based on 116 other fish from 12 lakes: $W = 2E\text{-}05L^2 - 0.0129L + 2.6311$ ($R^2 = 0.94$).

[E] Age (A) was estimated from weight (W) for 2 Kontrashibuna lake trout using a relationship based on 8 other fish in the same lake: $A = 20.845W - 1.8304$ ($R^2 = 0.75$).

[F] M = male; F = female; U = unknown.

[G] $\delta^{13}C_{l-f} = \delta^{13}C_{lipid\text{-}free.}$

[H] % lipid (L) was estimated from the molar C:N ratio (R) as: $L = 93/(1 + ((0.246*R - 0.775)^{-1})$ following Hoffman et al. (2015).

Table A.8 Quality assurance data from triplicate analysis of carbon and nitrogen stable isotope ratios in a subset of lake trout samples. Data include mean values for each triplicate, followed by twice the standard deviation (SD), representing an estimate of relative precision.

Park [A]	Lake name	Sample ID [B]	$\delta^{13}C$ (‰)	2 SD	$\delta^{15}N$ (‰)	2 SD
LACL	Turquoise	MSC489AA	-24.81	0.10	10.59	0.04
LACL	Snipe	MSC304AA	-23.29	0.07	10.98	0.07
LACL	Snipe	MSC310AA	-23.23	0.14	11.31	0.31
LACL	Lachbuna	MSC302Z	-25.98	0.12	13.30	0.16
LACL	Lachbuna	MSC310Z	-26.90	0.06	10.78	0.09
LACL	Crescent	MSC328AA	-22.04	0.73	15.45	0.69
LACL	Kontrashibuna	11LATR0045	-22.66	0.08	10.37	0.08
LACL	Clark	11LATR0029	-24.64	0.09	12.29	0.35
LACL	Clark	13LATR0007	-24.61	0.03	12.70	0.07
KATM	Kukaklek	MSC520AC	-23.51	0.05	15.90	0.08
KATM	Nonvianuk	MSC526AC	-25.72	0.03	13.07	0.31
KATM	Kulik	MSC197AC	-26.26	0.16	12.74	0.35
KATM	Kulik	MSC334AA	-21.34	0.08	12.85	0.27
KATM	Hammersly	MSC316AA	-25.60	0.56	9.62	0.24
KATM	Hammersly	MSC322AA	-23.24	0.56	9.73	0.29
KATM	Grosvenor	MSC508AC	-28.60	0.08	15.84	0.26

[A] LACL = Lake Clark National Park and Preserve; KATM = Katmai National Park and Preserve.

[B] Sample IDs match those in Table A.7.

Table A.9. List of fish- and lake-level factors considered for inclusion as covariates in the Bayesian hierarchical model, and an accounting of which factors were ultimately included.

Level	Factor	Units	Included?
Fish	Total length	mm	No
Fish	Weight	kg	No
Fish	Age	yrs	Yes
Fish	Condition	$g\cdot mm^{-3}$	Yes
Fish	Sex	male, female, unknown	No
Fish	$\delta^{13}C_{lipid\text{-}free}$	‰	Yes
Fish	$\delta^{15}N$	‰	Yes
Fish	Total C	%	No
Fish	Total N	%	No
Fish	C:N ratio	unitless	No
Fish	Day sampled	day of year	No
Fish	Latitude	decimal degrees	No
Fish	Longitude	decimal degrees	No
Lake	Elevation (of the lake)	m	No
Lake	Elevation (mean of the basin)	m	No
Lake	Glacier cover	%	No
Lake	Glacier loss	%	Yes
Lake	Turbidity	formazin nephelometric units	No
Lake	Salmon density (per m)	$salmon\cdot m^{-1}$	Yes
Lake	Salmon density (per ha)	$salmon\cdot ha^{-1}$	No
Lake	Distance to Novarupta	km	No
Lake	Volcano proximity (all volcanoes)	unitless	Yes
Lake	Volcano proximity (off-gassing volcanoes)	unitless	No
Lake	Depth (maximum)	m	No
Lake	pH (epilimnion)	unitless	No
Lake	Temperature (epilimnion)	°C	No
Lake	Water DOC concentration	$mg\cdot L^{-1}$	Yes
Lake	Water SO_4^{2-} concentration	$mg\cdot L^{-1}$	Yes
Lake	Wetland cover	%	No
Lake	Chlorophyll (epilimnion)	relative fluorescence units	No
Lake	Fish species richness	number of fish species	Yes
Lake	Plankton MeHg concentration	$ng\cdot g^{-1}$ (dw)	Yes
Lake	Bioaccumulation factor (bulk)	$\log(L\cdot kg^{-1})$	No
Lake	Bioaccumulation factor (63-188 µm)	$\log(L\cdot kg^{-1})$	Yes

Table A.10. Prior probability distributions and their characteristics for parameters in the Bayesian hierarchical model.

Parameters	Prior distributions	Characteristics
$\sigma_1, \sigma_2, \varsigma_v, \varsigma_\eta$	Half-$t_2(0,10)$	Weakly-informative
$\beta_{2:5}, v_l, \eta_m$	$\mathcal{N}(0,1000)$	Diffuse
Σ^{-1}	Scaled Wishart($s_{1:5} = 10, df = 2$)	Uniform for correlation, half-$t_2(0,10)$ for SD [A]
p_1, p_2	Beta$(1,1)$	Uniform over 0:1

[A] From Huang and Wand (2013).

Table A.11. Posterior predictive tests of the mean and standard deviation (SD) of lake trout THg (y) and plankton MeHg (W_2), based on observed and simulated replicate (rep) datasets. A perfect model fit would yield probability values of 0.5.

Discrepancy	Pr(Discrepancy > 0)
$\bar{y}_{rep} - \bar{y}$	0.64
$SD(y_{rep}) - SD(y)$	0.87
$\bar{W}_{2rep} - \bar{W}_2$	0.50
$SD(W_{2rep}) - SD(W_2)$	0.53

Figures

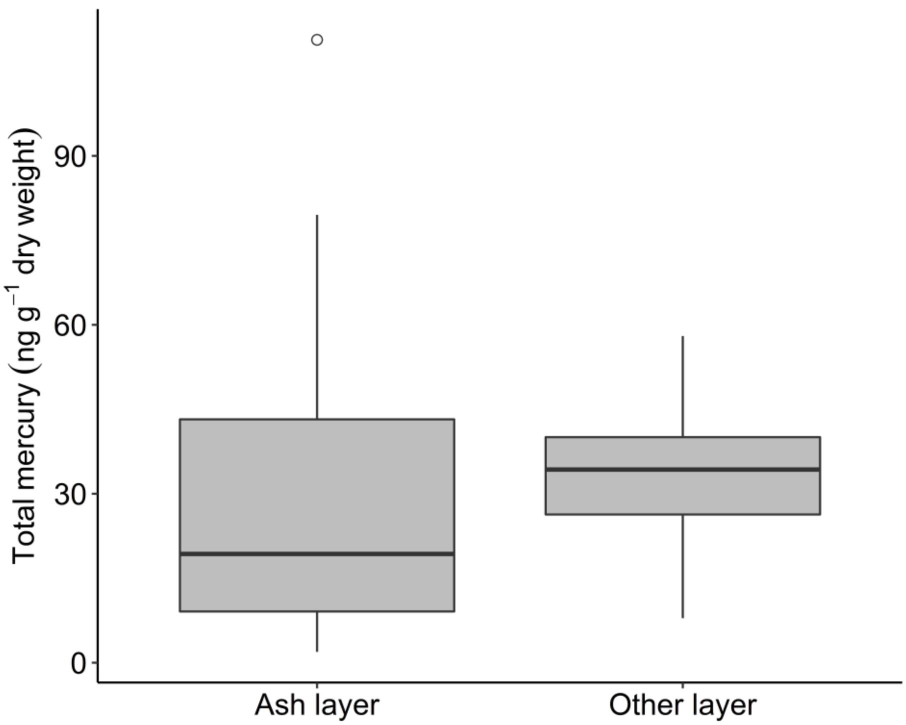

Figure A.1. Total mercury content in ash (n = 21) and non-ash (n = 11) layers of surface soil samples located in or near (within 5 km of) the basin boundaries of our study lakes. Samples were collected for park soil inventories in 2011, 2016, and 2017 (Wells et al., 2013, 2021; see Table S8 in Lepak et al., 2022). Distributions of total mercury do not differ among ash and non-ash soil layers (W = 98 and p = 0.50, based on a non-parametric Wilcoxon signed-rank test).

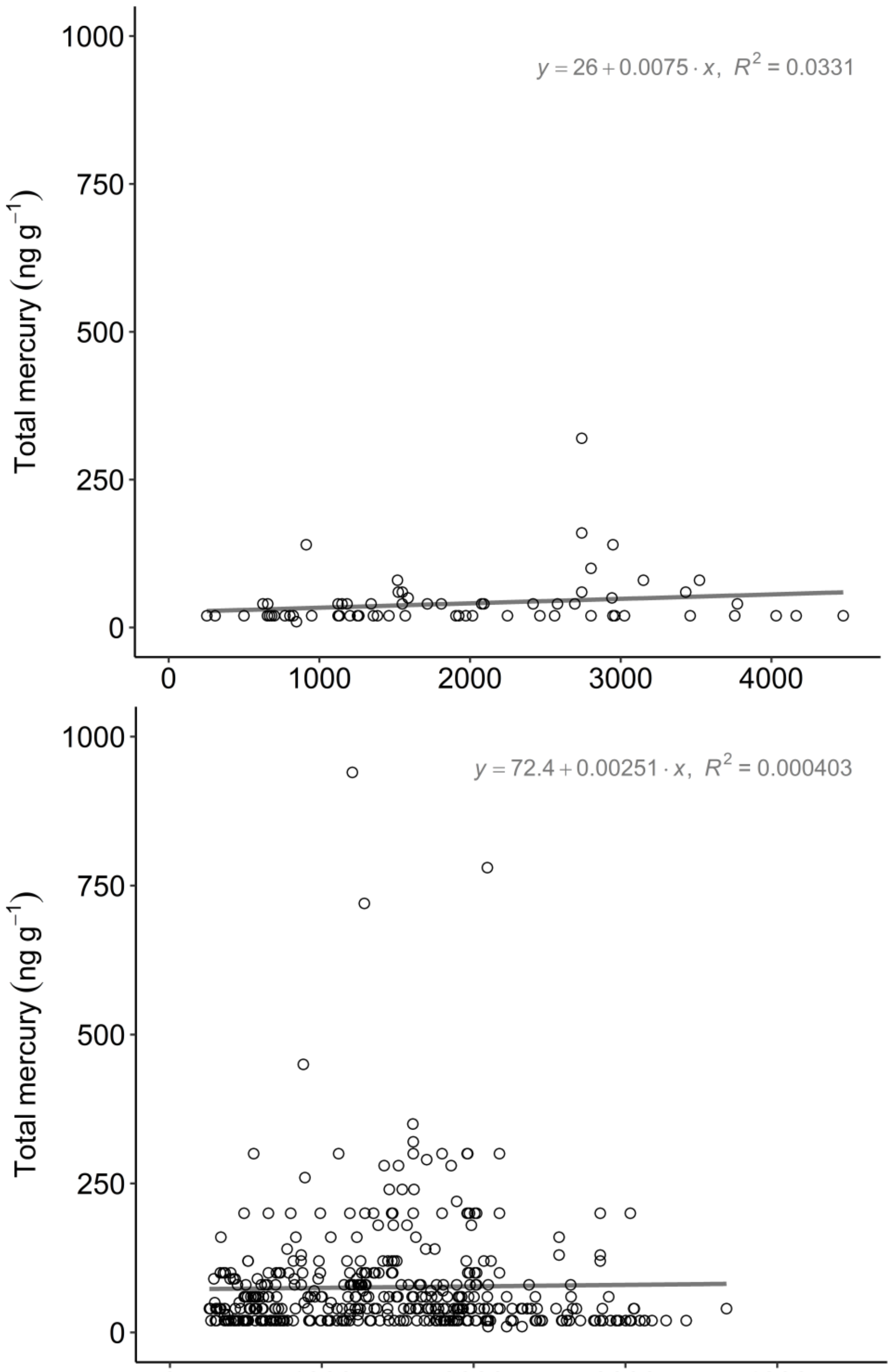

Figure A.2. Elevation vs. total mercury content in 73 rock samples (top; p = 0.12) and 450 sediment samples (bottom; p = 0.67) collected and analyzed previously by the USGS (Lee et al., 2016). Here, the USGS data were trimmed to include only samples collected within study basins that had glacier cover. These data support the idea that mercury concentrations of recently exposed bedrock and sediment near glacier margins upslope are likely comparable to those of surrounding areas downslope.

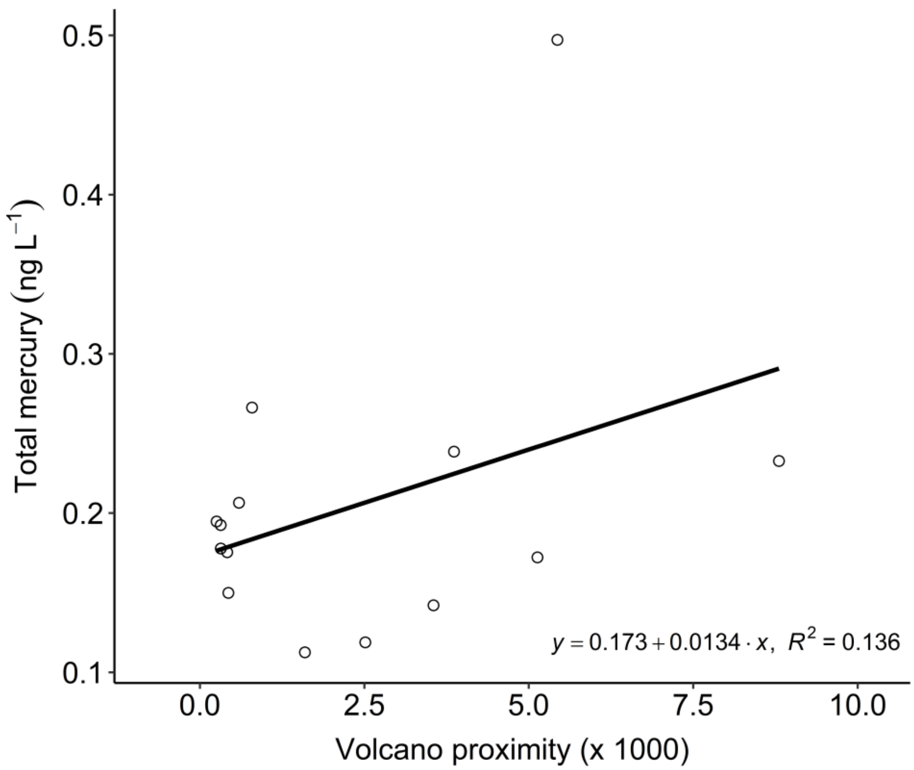

Figure A.3. Volcano proximity index vs. water total mercury content in our 14 study lakes (p = 0.20). The volcano proximity index is unitless; here it is multiplied by 1000 for ease of viewing.

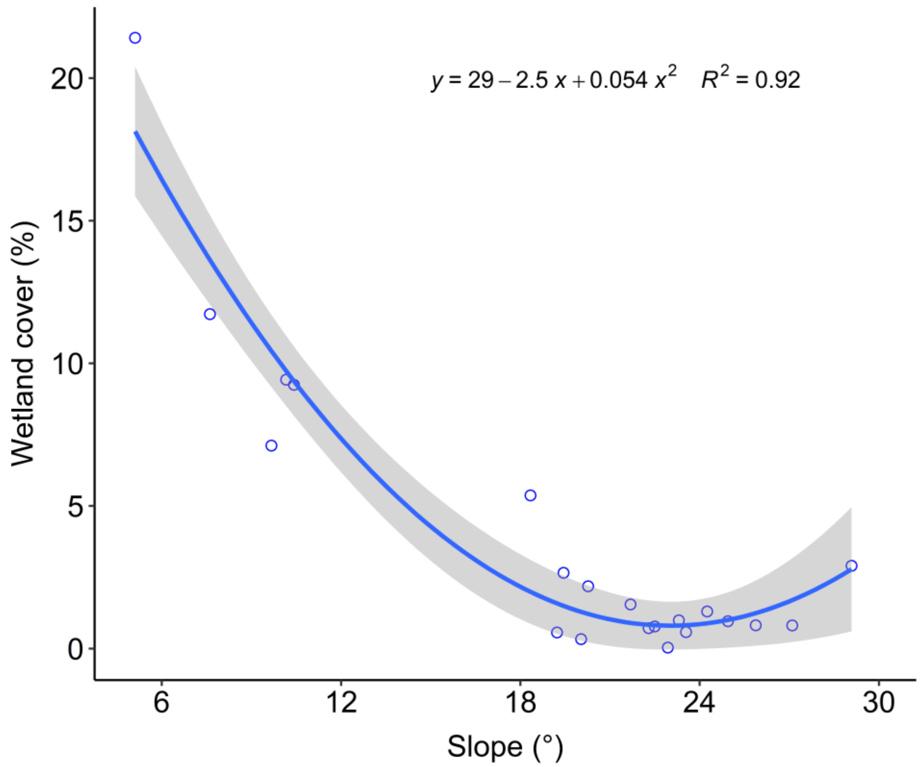

Figure A.4. Relationship between mean slope (°) and total wetland cover (%) in 21 lake basins (*p* <0.01), all but two of which were located within the boundaries of Lake Clark National Park and Preserve. The other two basins (Delight and Desire lakes) were located in another park in southwest Alaska: Kenai Fjords National Park.

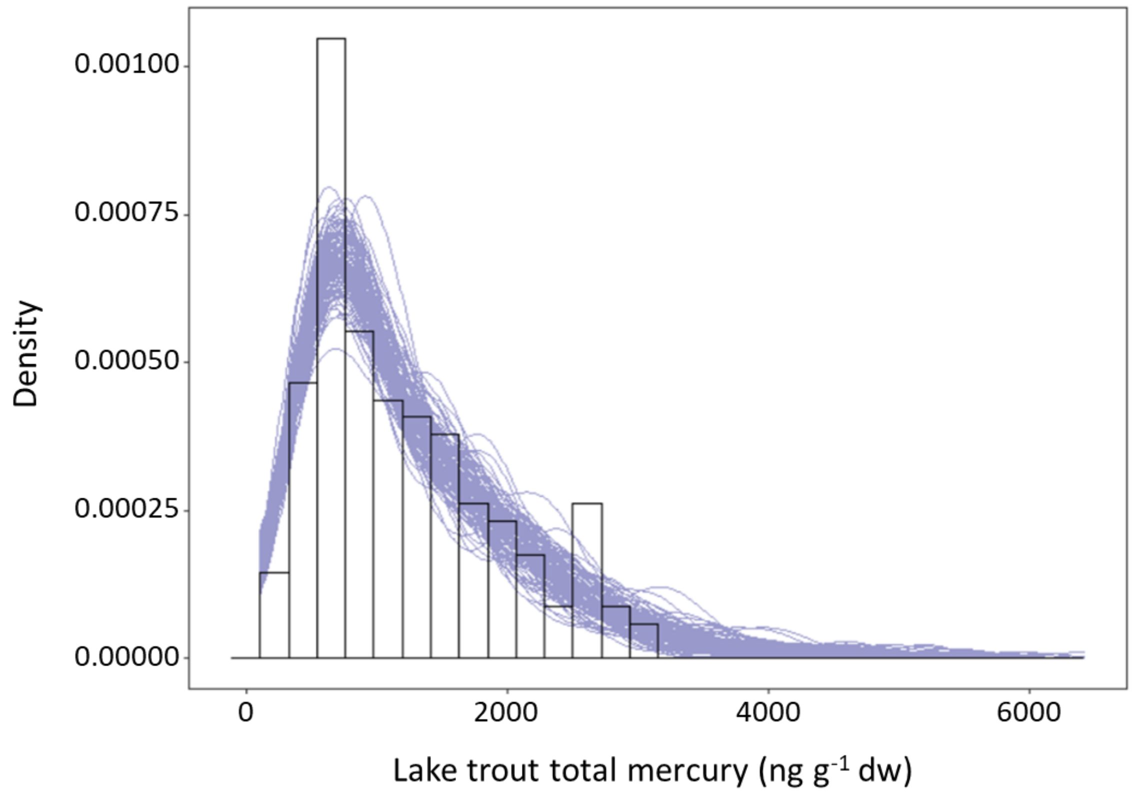

Figure A.5. Histogram of observed total mercury (THg) concentrations in lake trout (black bars), overlaid with density plots of 120 model-simulated THg datasets (blue curves). Note that the histogram is scaled to density rather than frequency to allow for comparison with simulated data.