

METADATA: Fish Mercury Datalayer for Canada (FIMDAC)

DOI: <http://dx.doi.org/10.6084/m9.figshare.1210773>

SUMMARY

Until now, characterization of mercury (Hg) risks posed to piscivorous fish and wildlife through the consumption of prey fish has generally remained limited to local or regional surveys. Furthermore, spatiotemporal and sample characteristic effects in fish-mercury data can lead to difficulty comparing results from different studies. The Fish Mercury Datalayer for Canada (FIMDAC, Depew et al. 2013a) provides model-derived estimates of Hg in a common indicator species (12-cm whole-yellow perch), and represents a useful preliminary national-level standardized index of Hg exposure to piscivorous fish and wildlife.

DESCRIPTION

The FIMDAC represents a model-derived output of Hg concentrations in a common indicator species (12-cm whole-yellow perch), established from the application of the United States Geological Survey's (USGS) National Descriptive Model of Mercury in Fish (NDMMF, Went 2004) to the Canadian Fish Mercury Database (CFMD, Depew et al. 2013b). The geographical distribution of yellow perch is wide-ranging, and they represent an important prey species for piscivorous fish, birds, and mammals. Parameters estimated by way of NDMMF were unbiased, and strong spatial biases in prediction error were not evident. The FIMDAC records represent the estimated Hg burden (ug/g, wet weight) for a standard length (12 cm) whole-yellow perch at 1936 unique freshwater sites across Canada, collected between 1990 and 2010. Further details regarding the development of the FIMDAC can be found in Depew et al. (2013a).

USE LIMITATIONS

The data represented in the FIMDAC is not suitable for use in the following applications:

1. human health risk assessments
2. assessing temporal Hg trends
3. precision fine-scale modeling
4. providing consumption advisories
5. establishing fishing regulations

SUGGESTED USES

It is suggested that the FIMDAC be used as a GIS layer for fish Hg data, in the following applications:

1. for use in spatial modeling of processes related to mercury deposition, methylation, and food web biomagnification,
2. for use in Hg eco-risk assessment across Canada,
3. for use as an indicator of aquatic MeHg levels across Canada, or
4. to use as a baseline (1990-2010) for future comparison with similar fish Hg data, to assess changes over time or due to Hg management initiatives at the national or international level.

RESOURCE IDENTIFICATION

TITLE: Fish Mercury Datalayer for Canada (FIMDAC)

ORIGINATORS: David C. Depew, Neil M. Burgess, Linda M. Campbell

PLACE KEYWORDS:

- Canada
- Nova Scotia
- New Brunswick
- Prince Edward Island
- Newfoundland
- Labrador
- Quebec
- Ontario
- Manitoba
- Saskatchewan
- Alberta
- British Columbia
- Yukon
- Northwest Territories
- Nunavut

TEMPORAL KEYWORDS:

1990 to 2010

THEME KEYWORDS:

- Fish Mercury Datalayer for Canada
- FIMDAC
- Canadian Fish Mercury Database
- CFMD
- atmospheric mercury
- Hg
- Methylmercury
- MeHg
- risk assessment
- modeling
- National Descriptive Model for Mercury in Fish
- NDMMF
- fish
- yellow perch
- *Perca flavescens*
- piscivorous
- freshwater
- lake
- river
- stream
- brook
- creek
- watercourse
- wetland
- marsh
- Great Lake
- St. Lawrence River
- ecozone

RESOURCE MAINTENANCE:

UPDATE FREQUENCY: not planned

SCOPE OF THE UPDATES: dataset

GEOGRAPHIC COVERAGE:

WEST LONGITUDE: -139.8

EAST LONGITUDE: -53.84

NORTH LATITUDE: 69.71

SOUTH LATITUDE: 41.86

POINT OF CONTACT:

PRIMARY RESEARCHER'S NAME: Dr. David C. Depew

ORGANIZATION'S NAME:

Watershed Hydrology and Ecology Research Division, Science and Technology Directorate,
Environment Canada

CONTACT'S POSITION: NSERC Visiting Government Fellow

CONTACT'S ROLE: originator

CONTACT INFORMATION

ADDRESS:

Watershed Hydrology and Ecology Research Division
Science and Technology Directorate, Environment Canada
867 Lakeshore Road
Burlington, Ontario
Canada

PHONE: +1 905 336 4790

E-MAIL ADDRESS: David.Depew@ec.gc.ca

DATABASE CONTACT: Dr. Linda M. Campbell

ORGANIZATION'S NAME:

Department of Environmental Science, Saint Mary's University

CONTACT'S POSITION: Senior Research Fellow in Environmental Science, Associate Professor

CONTACT'S ROLE: FIDMAC Database distribution

CONTACT INFORMATION

ADDRESS:

Department of Environmental Science, Saint Mary's University
923 Robie Street
Halifax, Nova Scotia
Canada

PHONE: +1 902 420 5737 (messages only)

E-MAIL ADDRESS: LM.Campbell@smu.ca

DATA QUALITY

LINEAGE STATEMENT

Source data for the Fish Mercury Datalayer for Canada (FIMDAC) came from the Canadian Fish Mercury Database (CFMD, Depew et al. 2013b), a collation of available freshwater Hg concentration data from 256 distinct sources representing all provinces and territories. The CFMD includes over 330 000 records, representing 104 species of freshwater fish collected from over 5000 locations across the country, between 1967 and 2010. Approximately 96% of the Hg concentrations in the CFMD were analyzed by way of cold vapour atomic absorption spectrometry. Initial screening of the CFMD to meet a set of predetermined criteria, followed by application of the National Descriptive Model of Mercury in Fish (NDMMF) resulted in the FIMDAC. Further details documenting the analytical methods, classification criteria, sample characteristics, quality control and quality assurance practices can be found in Depew et al. 2013a,b.

PROCESS STEP 1:

CFMD records underwent an initial screening to meet the following criteria:

1. freshwater sites exclusively
2. minimum of two species-sample types (may be two samples of the same species)
3. waterbody not known to be impacted by:
 - i. reservoir impoundment or designated as a downstream impacted waterbody,
 - ii. historical (or current) Hg pollution from chlor-alkali discharges, Hg or gold mine tailings,
 - iii. a recognized area of concern (AOC) in the Laurentian Great Lakes and St. Lawrence River.

PROCESS STEP 2:

To reduce the variability inherent in a dataset such as the CFMD, the resulting records from process step one (above) were further screened to ensure each record contained:

1. measurement of fish length,
2. measured Hg value using an accepted analytical technique,

3. portion types restricted to one of the following: skin fillet equivalent, whole fish, fillet with skin-on, whole fish - no viscera, fish composite, or unspecified fish composite.

PROCESS STEP 3:

Calibration of the NDMMF across all sampling events (location-year combinations) and different sample types (species-portion type combinations) was conducted. These values were used to derive estimates of slope for each sample type, and an intercept value for each event. Slope and intercept parameters were then used to derive estimates of Hg concentrations in specific sample types for a given sampling event. In total, the NDMMF was calibrated to 231,063 observations of fish Hg from 3547 locations, representing 207 sample types from 6614 events.

DATA COMPLETENESS AND ACCURACY

- The CFMD is not representative of a randomized sampling design, and the number of locations sampled represent only a fraction of the available lakes in Canada. Consequently, the FIMDAC may not adequately reflect the spatial distribution of Hg in typical forage fish across the country.
- Although the CFMD was screened for Hg contaminated sites, it cannot be definitively ascertained that all such observations were removed prior to the application of the NDMMF. Additionally, potential immigration or emigration of fish from contaminated locations cannot be ruled out.
- Data is representative of various analytical techniques (cold vapour atomic absorption was employed in approximately 96% of the studies highlighted in the CFMD), which are detailed in (Depew et. al. 2013b).
- Calibration of the NDMMF was poor at sites where conditions induce severe deviations from modeled species-type, Hg-length relationships, or if a small number of observations were available for calibration.
- Geographic location information provided by data partners was used to locate sampled water bodies using geographic information systems (GIS). In the absence of geographic data, locations were compared with printed topographical maps and (or) source document

descriptions of sample sites. If sample locations could not be identified with confidence, such sites were excluded from the CFMD, and consequently, the FIMDAC.

SOURCE DATA CITATIONS

SOURCE DATA CITATION 1:

TITLE:

Modeling mercury concentrations in prey fish: Derivation of a national-scale common indicator of dietary mercury exposure for piscivorous fish and wildlife

ALTERNATE TITLES: FIMDAC; Depew et al. 2013a

PUBLICATIONDATE: 2013-01-18

JOURNAL: Environmental Pollution

ISSUE:176

PAGES: 234-243

AUTHORS: D.C. Depew, N.M. Burgess, L.M. Campbell

SOURCE DATA CITATION 2:

TITLE:

An overview of mercury concentrations in freshwater fish species: a national fish mercury dataset for Canada

ALTERNATE TITLES: CFMD; Depew et al. 2013b

PUBLICATIONDATE: 2013-01-07

JORNAL: Canadian Journal of Fisheries and Aquatic Sciences

ISSUE: 70

PAGES: 436-451

AUTHORS:

D.C. Depew, N.M. Burgess, M. R. Anderson, R. Baker, S. P. Bhavsar, R.A. Bodaly, C.S. Eckley, M.S. Evans, N. Gantner, J.A. Graydon, K. Jacobs, J.E. Leblanc, V.L. St. Louis, L.M. Campbell

SUPPLEMENTARY DATA CITATIONS

SUPPLEMENTARY DATA CITATION 1:

TITLE:

A statistical model and national data set for partitioning fish-tissue mercury concentration variation between spatiotemporal and sample characteristic effects

ALTERNATE TITLE: NDMMF

REPORT: U.S. Geological Survey Scientific Investigation Report 2004-5199

PAGES: 15p.

PUBLICATION DATE: 2004

AUTHOR: S.P. Wentz

FIELD DESCRIPTIONS FOR FIMDAC DATASET:

PROVINCE_TERRITORY: Province of sample site

WATERBODY_NAME: Accepted Canadian Geographical Names Data Base name (toponym) or if missing, locally accepted name. Names are cross linked in the CFMD to a list of National Hydrological Network features (under construction) and Ecoregion classification themes.

WATERBODY_TYPE: Water body type is classified into 1 of 24 potential categories based on themes supplied with datasets or on interpretation of satellite imagery and topographical maps. Redundant features (e.g. stream, brook, creek) have been merged to "Watercourse". Every effort was made to ensure reservoirs, areas downstream of reservoirs, and flow diversion were appropriately spatially and temporally associated with data in the database, using decision rules outlined in Depew et. al. (2013a).

LATITUDE: Geographic Latitude of the defined centroid of waterbody entity (Great Lakes, Lake Winnipeg, Great Slave Lake, Great Bear Lake, Lake Athabasca and large hydroelectric reservoirs excepted). Geographic coordinates are in decimal degrees conforming to the North American Datum (1983).

LONGITUDE: Geographic Longitude of the defined centroid of waterbody entity (Great Lakes, Lake Winnipeg, Great Slave Lake, Great Bear Lake, Lake Athabasca and large hydroelectric

reservoirs excepted). Geographic coordinates are in decimal degrees conforming to the North American Datum (1983).

SAMPLE_YEAR: Year of fish collection.

YPERCH_HG: Model derived estimate of Hg (wet weight; ug/g) in a 12 cm whole yellow perch.

WATERBODY_ID: Unique waterbody identifier. This is the functional index linkage field for all other geographic data layers. Represented by a concatenated string of geographic coordinates in DDMMSSSSDDMMSS format for both latitude and longitude.

PE: Prediction Error (%). A measure of how well the model fits the observations at each location. PE describes the dispersion of error around the predicted values and is expressed as a % of the predicted values. Represents the region encompassing approximately 66% (+/- 1 stdev) of the observations. For example, if PE is 10%, then 66% of the observed Hg concentrations fall within 10% of the predicted Hg value. Discretion should be used when selecting record sets, paying attention to the PE value. PE may be used to screen site-year combinations from the database where predictions are comparably poor.

EVENT: Numeric variable assigned to data during pre-processing. Links model parameters for location - years to specific sites. NOTE: This should be used to screen out duplicate records. Duplicate records arise from contribution of data from two different sources for the same location-year event. Some locations have an Event designation as "NA". These sites did not meet the criterion for a minimum of 2 species-cuts presence. For this dataset based on yellow perch, alternative procedures were implemented to derive estimates of Hg in a whole yellow perch of similar size (12 cm). Briefly, sites where only yellow perch were collected were extracted from the database and Hg burdens in a 12 cm yellow perch were estimated using linear regressions or mean Hg concentrations if the size range was appropriate (10-15 cm length). For skinless fillet sample types, skinless fillet Hg was converted to whole fish Hg using a model specific to yellow perch in Kamman et al. (2004).

CONTACT_1: Name of organization or individual who provided raw input data for modeling.

Note: Records indicating "See Reference" refer to data culled from publically available sources. A full list of references and bibliographic information is provided in the Supporting Information of Depew et al. (2013b).

CONTACT_2: Name of additional contact. Indicates that two or more data sources were used for modeling.

METHOD: Indicates the method of estimation for N_pred_perch. "NDMMF" refers to estimation using model parameters, "SINGLE" refers to derivation using alternative means (see "Event" attribute - i.e. regression estimate or mean of select size classes).

METADATA DETAILS

METADATA CONTACT

POINT OF CONTACT: Dr. David C. Depew

ORGANIZATION'S NAME:

Watershed Hydrology and Ecology Research Division, Science and Technology Directorate,
Environment Canada

CONTACT'S POSITION: NSERC Visiting Government Fellow

E-MAIL ADDRESS: David.Depew@ec.gc.ca

DATABASE CONTACT: Dr. Linda M. Campbell

ORGANIZATION'S NAME: Department of Environmental Science, Saint Mary's University

CONTACT'S POSITION: Senior Research Fellow in Environmental Science, Associate Professor

CONTACT'S ROLE: FIDMAC Database distribution

E-MAIL ADDRESS: LM.Campbell@smu.ca

MAINTENANCE

LAST UPDATE: 2014-10-21

UPDATE FREQUENCY: not planned, as needed for contact information updates (e.g. changes in addresses)

METADATA STYLE: North American Profile of ISO19115 2003