*Conference of*
*New England Governors*
*and*
*Eastern Canadian Premiers*

# FISH TISSUE SAMPLING AND ANALYSIS PRACTICES

*in the New England States and Eastern Canadian Provinces*

A report of the

NEG/ECP Committee on the Environment

Mercury Task Force

Fish Tissue Workgroup

August, 2001

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## Introduction

In June 1998, the Conference of New England Governors and Eastern Canadian Premiers (NEG/ECP) adopted the Mercury Action Plan, which outlines an aggressive program of actions the New England states and Eastern Canadian provinces can take to reduce mercury emissions and protect the health of our citizens and the environment.

One section of the Plan addresses the need for coordinating jurisdictional fish tissue sampling and analysis practices, with respect to the exchange of information. In a September 2000 New England Governors' Conference, Inc. resolution, the region's governors also asked that state agencies work together in this effort.

For jurisdictions generating fish tissue mercury data, it is often well understood within the given jurisdiction what the objectives of the activity and details of the sampling and analysis are. However, frequently these details are not reported. As a consequence, those outside of the jurisdiction may not be able to fully interpret the data as it is presented, thereby limiting its usefulness.

This paper offers recommendations on the reporting of fish tissue mercury data to facilitate the sharing of information and to allow a wider audience to interpret the data and fully understand its meaning. Specifically, more detailed reporting will make it possible to:

- judge whether data from multiple sources or jurisdictions can be integrated to provide a regional perspective of mercury levels in fish;
- understand differences between datasets and any factors that may confound sta tistical comparisons;
- identify the geographical location of sample collection sites to ensure accurate identification of multiple sites with the same name and to allow the mapping of data on a local or regional basis;
- distinguish between data used in human assessment and ecological assessment;
- compare data against consumption limits or similar size classes;
- know the mercury species being measured (total Hg vs. MeHg), and
- assess the context in which the data were collected to ensure a better under standing of how data can be used.

By enhancing the reporting of sampling and analysis details, many of the ambiguities surrounding reported fish tissue data may be resolved, improving the utility of these data within and across jurisdictions.

## Sharing of Mercury in Fish Tissue Data: A Case Study

To obtain a Canadian perspective of mercury contamination, a National Database on Mercury Levels in Freshwater Fish was assembled by the National Guidelines and Standards Office of Environment Canada. Concentrations of mercury in fish samples were obtained from various governments (*e.g.*, provincial, federal), corporations (*e.g.*, hydro companies), and previously published reports. Datasets acquired consist of 70+ files which contain collectively over 230 000 data points, encompassing most regions of Canada. To facilitate comparisons, datasets were assembled into a single, standardised database, consistent in structure and content. This exercise was challenging owing to the diverse nature of the individual datasets. By reporting the challenges this effort presented, the benefits of consistent reporting of mercury in fish data will become apparent.

The integration of individual datasets into the national database involved accessing the data, manipulation of the layout of the dataset, and conversion of any coding (*e.g.*, fish size) into standardised format/units. The four biggest hurdles were accessing data, coding, use of common names for fish species, and poorly defined sample sites.

Datasets received from the various sources were in numerous formats (*e.g.*, dBase, SAS, Lotus) and were often not compatible with current software. Every effort was made to convert these files. In a few extreme cases, some files were excluded because they could not be accessed.

Coding of data was common, and led to the loss of critical data.. For example, codes for fish size were typically for a range in length (*i.e.*, code 1 = 10 to 20 cm; code 2 = 21to 30 cm and so on). Consequently the exact length of the fish could not be determined. Moreover, coding was unique to each dataset so each dataset had to be decoded separately.





Some common names for fish species are relatively standard (*e.g.*, rainbow trout) while others may be regional, and non-descript (*e.g.*, whitefish). One common name can often apply to several species (*e.g.*, turbot). It was time consuming to ascertain the scientific name.

By far, the most laborious aspect of the database development was entering missing geographical co-ordinates. Doing so was critical to our database for two reasons. First, we wanted the database to be geo-referenced so that levels of mercury in fish could be mapped with GIS. Second, several lake and river names are very common (*e.g.*, Clear Lake; Little River) and more than one water body with the same name can exist within a relatively small area. It was not always possible to determine accurately specific co-ordinates, for example, when samples represented averages of several sites, or for large lakes and rivers.

We noted several other inconsistencies in reporting among the datasets. Not all datasets reported the same type of data. For example, size of fish could be based on weight or length, and sometimes neither was recorded. Reporting of similar types of data even varied. Some data we could adjust (*e.g.*, convert all lengths reported in mm to cm) while others we recorded in the comments field of the database so that future comparisons and statistical analyses could be conducted with confidence. Variations in reporting included: total length vs. fork length; soft body weight vs. whole weight; and total mercury vs. methyl-mercury. Sometimes, it was not clear exactly what was being reported, limiting the statistical use of these data.

An attempt was made to determine or confirm collection and measurement methods, analytical protocol, and QA/QC, for datasets for the various regions of Canada. This information was not incorporated directly into the database, but rather documented in a companion report.

Based on these experiences, a number of recommendations on reporting can be made and are discussed in the main body of the present report. Overall, our experiences show it is imperative to record as many details as possible about the nature of the data. Similar types of information should be reported in all datasets, and include minimally the fields outlined herein. The details should be clear such that others less knowledge-

able about the particulars of a specific monitoring program can understand the data. Each unknown in a dataset decreases the level of confidence and limits its utility in analyses. By implementing these recommendations, analysis of the various programs and data will determine if meaningful regional comparisons are possible.

## Jurisdictional Fish Tissue Sampling Practices

The information provided in this report on the jurisdictions' acquisition & use of fish tissue data was developed as the result of a survey conducted by the fish tissue workgroup. The survey was distributed to the appropriate parties for each New England state and Eastern Canadian province. Parties surveyed were asked to respond to the question "how does your jurisdiction consider the points presented in the survey outline?". A compilation of the survey responses, by jurisdiction, is presented in matrix form at the end this report.

A description of the survey data points are as follows:

### I. Fish Sampling

a. Human Health

1. Legal Limits

When the objective(s) of the activity is related to human health two types of limits are generally considered. The first is legal catch limits. This can be described as the minimum fish length of a specific fish species that is allowed to be kept for consumption under a sports fisheries. The second is human consumption limit. This is described as the maximum concentration of a chemical contaminant allowed in edible fish tissue.

2. Species of Interest

There may be several factors involved when considering species of interest. The primary factors are likely to be edibility and





popularity as table fare. However, what is being consumed is likely related to species geographical and habitat distribution e.g. cold water vs warm water species and lentic vs lotic systems. Where populations whose food base consist largely of fish and, in particular fish perhaps not commonly consumed by the general population, the focus would be expanded to several additional species with perhaps a less conservative interest in size. Lastly, an additional focus for bioacummulative or persistent contaminants would be those species or age classes which tend to accumulate and concentrate contaminants.

b. Ecological Assessment

1. Legal Limits

From a non-human ecological perspective there is actually no "legal" limit. There may however be what can be described as a consumptive limit. This would be the maximum concentration of a contaminant in the fish tissue consumed that would not illicit detrimental acute or chronic impacts.

2. Species of Interest (trophic levels, feeding guild, foodchain modeling, etc.)

Targeting of species is likely to focus on species selection based on the assemblages and community members present (both aquatic and terrestrial). What are the predators eating ? What species would come in close contact with the media of interest? As above what species and age classes are most likely to accumulate contaminants of interest? The focus may include a top water predator species, a bottom feeding species and a forage species.

c. Sampling Method

The sampling method choices employed are numerous. They may not be significant as a general consideration within the objectives of this survey, but nonetheless was included in the survey as a significant consideration in the actual field sampling process. These methods include:

1. Gill Netting
2. Hoop/Trammel nets
3. Sienes
4. Electrofishing
5. Hook & Line

What is actually used is dependent on the size of the water body, the depth of the water body and the species of interest. Electrofishing may be the first choice with the necessary access and a depth that does not exceed the capabilities of the equipment. For wadeable stream backpack shockers would be appropriate. For water bodies with boat access and a depth ranging between 3 and 15 feet boat shocking is reasonable. With water bodies deeper than 15 feet or minimal boat access gill nets, hoop or fyke nets, seines and trot lines are the sampling equipment of choice.

d. Seasonal Issues

Seasonal issues other than the obvious are likely to revolve around targeting of worse case scenarios. For example, later in the fall fish are more likely to have higher contaminant levels particularly lipophilic contaminants. The same may be said during pre-spawn where contaminants tend to concentrate in the roe. With regard to sample comparability, it would perhaps add to the comparability if a specific date of collection was always identified and that samples being compared were taken at approxi-





mately the same time of year.

e. Community/Population Representation

Is the sampling type commonly used made up of individuals or composites? Individual fish may provide a worst case scenario. The composite sampling would provide more of an average exposure evaluation. What are the number of replicates in a composite? Is there a target size range for composites e g. .fish in a composite would be within a range of 25% by weight between largest and smallest. In the case of samples consisting of small fish, samples sizes may be developed to accommodate analytical weight requirements. The number of samples either individual or composite may be dictated by the size of the water body, the assemblage being evaluated and statistical power required.

Measurement of physical attributes such as length, weight and age are also important considerations. How determinations are made should also be included where possible. For example, length can be taken as total or forked and ageing may be performed via scales, spines and/or otoliths depending upon the species.

## II. Fish Sample Preparation

a. Human Health

Fish samples for human health evaluations are performed primarily through analysis of fillets. Skin is either removed or, left on with scales removed, depending upon the species and/or the requirements of the jurisdiction. Whole Body analysis may be performed when a geographical area of study includes human communities whose food base consists largely of fish and at least some may be prepared in a "stew-like" manner.

b. Ecological Assessment

If the purpose of the sampling effort is restricted to non-human exposure, whole body analysis is performed. This could either be in the form of composites or individuals.

If human and non-human concerns are involved, fillet and offal (everything not taken for fillet samples) are analyzed. Fillet results are use for human health issues and whole body concentrations can be had from fillet and offal data reconstruction.

## III. Analytical Technique

a. Method of Analysis

The analytical technique is the process that encompasses the point when the tissue sample is processed in the laboratory in preparation for instrumental analysis through the actual analysis. There are several methods in use. The differences can be found in both the processing and instrumental analysis aspects. Therefore, specifically identifying the method of choice is important.

b. Reporting Limit

The reporting limit is described as the minimum reportable limit that can be achieved by the method employed for the matrix, i.e. fish tissue being analyzed.

c. Speciation

Mercury is analyzed for as primarily two forms, total mercury and methyl mercury. Total mercury is a summation of the inorganic and organic forms. The organic form of greatest concern is methyl mercury (meHg). In the case of fish tissue analysis, the majority of mercury detected as total mercury is in the methylated form. Documentation of which form is being analyzed for may be an important consideration.





## IV. Data Management

Management of data is an important consideration when examining fish tissue data. For this survey a discussion of data management is meant to answer the question; what efforts were performed in the study to ensure that the resulting data were credible? Additionally, was there a subsequent evaluation of data usability. The following are examples of tools used to ensure data credibility:

*The development and adherence to a quality assurance plan (QAP)*

Within the QAP detailed information includes data quality objectives, sampling methods for use, sample handling, quality control parameters and measurements, necessary sample size and type needed e.g. fillet, offal, target species, sample processing technique, analytical techniques, sample and data security needs and data usability requirements. The level of quality control is dependent upon the intended use of the data. Measures which can be taken to ensure high quality and credible data include:

- tissue performance evaluation (PE) check sample analysis
- use of a fish tissue blank
- field duplicate
- laboratory duplicate and spikes
- instrument calibration confirmation checks
- Data validation and usability evaluation

## V. Data Presentation

*Data Reporting Format*

Simply stated, data can be presented in primarily two forms. The first being a wet weight basis and the alternative a dry weight basis.

## VI. Data Storage and Access Capability

*Data Storage*

Storage of data is done so in an electronic format, as a hard copy or a combination of both. Storage in a electronic format may simply mean use of spreadsheets within reports maintained at the place of origin or data may be input into a much larger database such as STORET of EDAS. Hardcopies of data reports may also be copied and stored in a file storage room as part of an organization's file storage system. Further consideration may also be given to the inclusion of peripheral data, e.g. metadata and QA elements.

*Access Capability*

Accessibility may be an important issue when considering the potential for data exchange. Points to be considered may include data format ( hardcopy or electronic), listing of data reports on file, location of this list for common viewing( website?), contact person and means and ease of access.





## Conclusions

All of the jurisdictions are presently engaged in some level of monitoring fish tissue for mercury; in at least one instance, fish tissue sampling and analyses date back to the 1960s.

While the objectives of the fish tissue sampling programs may vary by jurisdiction, the underlying science driving the design of the sampling programs and analytical procedures is sound, and the data generated by these programs is valid.

Consequently, there is a considerable body of fish tissue sampling and analytical data within the region. Based upon the similarities among the programs, there exist opportunities to distribute and share data on a regional basis where such data is comparable, and lends itself to contributing toward a regional perspective.

Uncertainties associated with the data (such as assumptions underlying the design of the study or in the interpretation and documentation of analytical results) inhibit the broader use of this information by the jurisdictions within the region in subsequent studies and projects.

To alleviate this situation, and facilitate the use of this data to its fullest advantage, the Fish Tissue workgroup of the NEG/ECP Mercury Task Force make the following recommendations for promoting the regional exchange of this data. Underlying these recommendations is the belief of the workgroup that **clarity**, in the design of the sampling program, in the analytical protocols, and in the documentation and reporting of results is critical not only to the sponsoring jurisdiction, but also to the further distribution and use of this data by other interested parties.

**Recommendations**:

- Nomenclature – Fully identify species of interest by its scientific name
- Program/Project Design – Fully articulate any assumptions made in the design of sampling and analytical protocols

- Sampling Date and Location – Tag/label samples with sampling date and geographic locator (e.g. Lat/Long, Northing/Easting coordinates, etc)
- Results – Fully describe analytical results by chemical species and in common units of measure
- Data Format – Enter program/project data in compatible database format
- Data Harmonization – Recognize and take advantage of opportunities to harmonize data throughout the region; work towards data harmonization





# APPENDIX

# Matrix of Fish Tissue Sampling and Analysis Protocols in the New England States and Eastern Canadian Provinces

Prepared by the

**Fish Tissue Workgroup**

of the

NEG/ECP Committee on the Environment
Mercury Task Force

**Note**: at the time this matrix was drafted, information was unavailable for Prince Edward Island and Rhode Island. Information for these two jurisdictions is under development and will be available in future drafts. The Newfoundland Department of Environment does not conduct any fish tissue sampling for mercury content. In Newfoundland and Labrador the Federal Department of Fisheries and Oceans have conducted fish tissue studies in the province, and Newfoundland Hydro performs tissue studies in their hydroelectric reservoirs. It is intended to incorporate this information in furture drafts.

**ACQUISITION & USE OF FISH TISSUE DATA**

**Section I: Fish Sampling**

| Section I.a **Human Health** | **Connecticut** | **Maine** | **Massachusetts** | **New Hampshire** | **Vermont** | | Section I.a **Human Health** | **New Brunswick** | **Nova Scotia** | **Québec** | **U.S. EPA** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Legal Limits (Consumption Limits) | | – 0.2 ug/g limited consumption for women of childbearing age and children under 8.<br>– 0.6 ug/glimited consumption for general population. | Sensitive pops advised not to eat any fish of affected species if mean Hg level between .5 ug/g and 1 ug/g.<br>– If mean concentration of all fish in waterbody exceeds 1 ug/g, all citizens advised not to eat the fish. | Generally only legal-sized fish are evaluated. | | | Legal Limits (Consumption Limits) | Legal limit is 0.5 ug/g. | Health Canada guideline for Hg is 0.5 ug/g - used to set gamefish consumption guidelines. | Legal limit 0.5 ug/g. | Dependent upon state in which work is being done. |
| Legal Limits (Catch Limits) | | | | | | | Legal Limits (Catch Limits) | | Yes | | |
| Species of Interest (Scientific or Common Nomenclature?) | Large-mouth bass, small-mouth bass, bluegills, yellow perch, eel, panfish, brown trout, walleye, chain pickerel (other species collected). | – freshwater game fish.<br>– bluefish & striped bass in maritime water.<br>– FDA advisory on shark, swordfish & tuna. | Generally MA sampling targets largemouth bass, yellow perch and bullhead. Other species on case-by-case basis. | Have data on 22 species, but focus on most commonly eaten species. - largemouth bass, smallmouth bass, eastern chain pickerel, yellow perch, white perch & brown bullhead., brook, rainbow & lake trout. | Edible tissue data available for 17 species of fresh water fish, including smallmouth bass, pickerel, sunfish and brown bullhead. | | Species of Interest (Scientific or Common Nomenclature?) | Brook Trout, various sizes. | Common Names: Brook trout, white perch, smallmouth bass, Atlantic salmon, striped bass, chain pickerel, yellow perch. Scientific names recorded also. | Walleye, Northern pike, lake trout, yellow perch. | Again, somewhat dependent on state. |

**ACQUISITION & USE OF FISH TISSUE DATA**

| Section I.b **Ecological Assessment** | **Connecticut** | **Maine** | **Massachusetts** | **New Hampshire** | **Vermont** |
|---|---|---|---|---|---|
| Species of Interest (Scientific or Common Nomenclature?) | Trophic levels and feeding guilds considered. | – Studies on impacted loon populations.<br>– Other birds being studied.<br>– Mink and river otter. | MA fish testing to date has focused on human health assessments, but further research on ecological impacts and impacts on piscavorus species. | The NHPHL only analyzes legal-sized fish for human health assessment. NH DES has done some analysis on smaller fish for ecological assessment purposes. | VT Fish Contaminant Monitoring Program has centered on edible portions only (no whole body samples taken). |

| Section I.b **Ecological Assessment** | **New Brunswick** | **Nova Scotia** | **Québec** | **U.S. EPA** |
|---|---|---|---|---|
| Species of Interest (Scientific or Common Nomenclature?) | No. | Yes, but only in Keji Park by Environment Canada. Common & scientific names recorded – brook trout, white & yellow perch included. | No. | |

| Section I.c **Sampling** | **Connecticut** | **Maine** | **Massachusetts** | **New Hampshire** | **Vermont** |
|---|---|---|---|---|---|
| Method (netting, electrofishing, etc.) | Dependent on phase. Trappers for mammals, night-lighting & mist-nets for birds. | Angling, gill nets, trap nets, electofishing, seines | Various methods used. | Mainly electro-fishing and hook/line, some seines and gill netting. | Mainly electro-fishing. |
| Date Reporting Format (dd/mm/yy,etc.) | | | | | |
| Location Characterization (GPS, etc.) | | | | | |
| Location Characterization (Waterbody Description) | | | | | |

| Section I.c **Sampling** | **New Brunswick** | **Nova Scotia** | **Québec** | **U.S. EPA** |
|---|---|---|---|---|
| Method (netting, electrofishing, etc.) | Gill netting & hook/line. | Mainly electro-fishing and hook/line, some seines and gill netting. | Gill netting. | Many methods, dependent on study and conditions. |
| Date Reporting Format (dd/mm/yy,etc.) | | Date Recorded as mm/dd/yy. | | |
| Location Characterization (GPS, etc.) | | Geographic coordinates generally recorded. | | |
| Location Characterization (Waterbody Description) | | Characterized by type (lake, stream, pond, etc.) | | |

**ACQUISITION & USE OF FISH TISSUE DATA**

| Section I.d Seasonal Issues | Connecticut | Maine | Massachusetts | New Hampshire | Vermont |
|---|---|---|---|---|---|
| Seasonal Issues | Phase 2 of CT study indicated seasonality may be a factor. | Not addressed at DEP, though sampling done by state universities. | Sampling usually conducted in the spring to fall period. DEP instituting research project on seasonal variability. | Most collection done in summer but some through ice in winter. State has closed season for bass between MaY 15 and June 15. | All samples collected between late-May and August, with the exception of lake trout (all year). |

| Section I.d Seasonal Issues | New Brunswick | Nova Scotia | Québec | U.S. EPA |
|---|---|---|---|---|
| Seasonal Issues | Sampling conducted May to October. | Sampling conducted in the summer (May to Sept). Sampling date recorded. | Sampling done June through October. | Incorporated in studies, usually based on worse case scenarios. |

| Section I.e Community & Population Representation | Connecticut | Maine | Massachusetts | New Hampshire | Vermont |
|---|---|---|---|---|---|
| Individual Fish | See section I.a. | For human health | MA uses samples from individual fish. | Almost all analysis on individual fish. | |
| Composites | Not undertaken. | For wildlife consumers | Composite samples from three fish are used under certain conditions. | Sometimes for special studies. | |
| No. of Replicates No. of Composites | 3 replicates. | Varies, usually 5-10 (sometimes 20) individuals or 2-4 composites of 5 individuals. | When composites are used the collection goal is three sets of composites comprised of three fish each. Lab duplicates are routinely analyzed. | Composites generally 5 fish; replicates dependent on study. | Database comprised of a mix of 2-8 fish composites with individual samples. Composite size comprised of 5 fish. |
| Fish Length, Weight & Sex Determination | Actual, then normalized. | Total length & weight always recorded. | Data on fish length is routinely collected. | Determined in field or upon return to lab. | Fish lengths usually close to the lowest legal limit size. |

| Section I.e Community & Population Representation | New Brunswick | Nova Scotia | Québec | U.S. EPA |
|---|---|---|---|---|
| Individual Fish | | Study-specific analysis done on individual fish. (1-20 individual fish sampled per lake). | For walleye, northern pike and lake trout, 10-15 fish per site. | Yes, provides worse case scenario, though expensive. |
| Composites | | Study-specific composites by species taken in provincial survey. (Used a 5 fish composite in one survey). | Yellow perch, others 5-10 fish by composite, 3 composites by species | Yes, to provide more average exposure evaluation. |
| No. of Replicates No. of Composites | | Replicates generally taken but dependent upon sample size. | | No. of replicates usually 5 fish/composite. Each composite by weight would be within 25% of others. |
| Fish Length, Weight & Sex Determination | | Total lengths & weight recorded. Sex recorded in some surveys. | Total length, weight & sex. | |

**ACQUISITION & USE OF FISH TISSUE DATA**

**Section II: Fish Sample Preparation**

| Section II.a Human Health | Connecticut | Maine | Massachusetts | New Hampshire | Vermont | | Section II.a Human Health | New Brunswick | Nova Scotia | Québec | U.S. EPA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Fillet (Skin on/off) | Skin off. Boneless. | Skin off | Fillets, skin-off. | Usually fillets, skin-off. | Skin removed for yellow perch, brown bullhead and pumpkin-seed, and left on for others. | | Fillet (Skin on/off) | Fillets, skin-off. | Fillets, skin-off. | Fillets, skin-off. | Fillets, skin on or off depending on species. |
| Whole Body | | | Not used for consumption advisories for mercury. | Smelt were analyzed as whole fish. | No whole body samples have been taken for state programs. | | Whole Body | | No. | Only for white sucker. | Sometimes, as demanded by study. |

| Section II.b Ecological Assessment | Connecticut | Maine | Massachusetts | New Hampshire | Vermont | | Section II.b Ecological Assessment | New Brunswick | Nova Scotia | Québec | U.S. EPA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Whole Body | No. | Whole fish | No routine data collection to date. Future efforts will rely on whole body samples or whole fish concentrations as determined from fillet and offal. | Yes – yellow perch less than 6" analyzed as 5 whole fish composites; CT River study analyzed fillets and offal. | See above. | | Whole Body | No. | Not in provincial surveys, but federal assessments may have. | Only for detection of organic contamination, not Hg. | Used if purpose is restricted to nonhuman exposure. |
| Reconstruction of Data from fillet and offal | No. | | See above. | No – only for CT River study. | | | Reconstruction of Data from fillet and offal | | No. | No. | Used if human and non-human exposure studied. |

**ACQUISITION & USE OF FISH TISSUE DATA**

**Section III: Analytical Technique**

| Prep & Analtyical Method | Connecticut | Maine | Massachusetts | New Hampshire | Vermont |
|---|---|---|---|---|---|
| Sample Preparation | Method is a modification of EPA method 245.6. | Digestion: EPA 245.6, Analytical: cold vapor atomic absorption spectrometry. | Samples are prepared as required for study. Fish are rinsed with ambient water, wrapped in aluminum foil, placed in Ziploc bags and placed on ice for delivery to lab within 24 hrs. | Prep: Muscle taken from right side, near lateral line, starting above pectoral fin. Flesh cut to spine, starting near pectoral fins and cutting to center of dorsal fin. | |
| Analytical Method | | | | Analytical: Portion between 1-2 grams placed in Teflon vessel with 8 mls nitric acid and 2 mls hydrogen peroxide. Digested for ½ hr. Samples then analyzed on a Perkin Elmer, FIMS Hg analyzer. | |
| Contaminants of Interest | Total mercury ug/g wet weight. | Total Hg (also CD, CR, CU, PB, SE, ZN, organochlorine pesticides, PCBs, dioxins). | Depends on scope of study. May focus solely on Hg. | Hg. Some special studies on PCBs. | Mercury (others?) |
| Analytical Reporting Limits | ug/g wet weight. | MDL=0.001 ppm, RL=0.0025 ppm. | ??? | 10-120ppb, off the FIMS Hg analyzer. | |
| Contaminant Speciation (Total Hg. Vs. meHg) | None. | Total Hg only. | Total Hg only. | Total Hg, wet weight. REMAP study looked at both wet and dry weight for total and methyl Hg. | |

| Prep & Analy-tical Method | New Brunswick | Nova Scotia | Québec | U.S. EPA |
|---|---|---|---|---|
| Sample Preparation | Coal paper atomic absorption. | Fish are rinsed with ambient water, wrapped in aluminum foil, placed in Ziploc bags and placed on ice for delivery to lab within 24 hrs. Muscle tissue extrated as required. | See Quebec sampling protociol. | Fish sample dried and then wet-digested in aqua-regia. The analysis is cold vapor method EPA #245.5. |
| Analytical Method | | Cold vapor atomic absorption techniques were used. | | |
| Contaminants of Interest | Mercury. | Mercury. | Mercury, selenium, arsenic. | |
| Analytical Reporting Limits | Detection & Quantifification limit: 0.01 ug/g. | Detection limit 0.01 ug/g, wet weight, quanti-fication limit .03 ug/g. | Detection limit 0.01 ug/g, quantification limit 0.03 ug/g. | Quantification Limit 0.05 ug/g dry weight, 0.002 ug/g wet weight. |
| Contaminant Speciation (Total Hg. Vs. meHg) | No speciation. | No. Total Hg only. | Total Hg, no speciation, consider more than 90% is mHg in fish. | Normally assumed that 90% of Hg is methyl mercury. |

**Section IV: Data Management**

| Quality Assurance | Connecticut | Maine | Massachusetts | New Hampshire | Vermont |
|---|---|---|---|---|---|
| Quality Assurance Plan Developed and Followed | "Preliminary Assessment of Total Mercury Concentrations ..." (ERI 2/96) used for QAPP. | REMAP QAPP followed for field collection, lab QA plan for analytical. | QAPPs have been developed and followed for all fish sampling efforts. | Special studies have QAPPs developed and followed. | US EPA-approved QAPP used. |
| Tissue Performance Evaluation Analysis | For every 20 samples, 2 lab spike analysis, a lab duplicate, a lab control spike and a lab preparation blank were analyzed. | DORM 2 Dogfish muscle from National Research Council of Canada. | US EPA procedures are followed. | | Internal QC checks include matrix and analytical duplicates to be conducted on 5% of samples. |
| Tissue Blanks | n.a. | At 5% of total number of samples. | Samples are analyzed within holding times specified in EPA guidance for chemicals of concern. Samples have not been banked. | | A portion of samples are archived. |
| Data Validation Level | CT DEP performed tier 2 data validation. | Data quality objectives (DQOs) are set for all analysis and are checked by lab and by DEP project officer. If DQOs not met, samples are re-analyzed. | | Samples were analyzed in groups of 10. For each group, a method blank, a blank spike, and a sample spike were analyzed. The spike recoveries had to be between 80-120% for the data to be accepted. | Precision is calculated from analytical duplicates, duplicate analysis of quality control reference sample, or matrix spike duplicates. |

| Quality Assurance | New Brunswick | Nova Scotia | Québec | U.S. EPA |
|---|---|---|---|---|
| Quality Assurance Plan Developed and Followed | | Yes, each study had QAPPs developed and followed. | | QAPP followed for every sampling. |
| Tissue Performance Evaluation Analysis | DORM, DOLT, TORT. | QC checks in lab included use of analytical dup-licates, blanks, spiked samples and reference materials. | Use DORM, MA-A-1. | PE sample analyses, tissue blanks, field duplicates, lab duplicates & spikes, and instrument calibration/checks. |
| Tissue Blanks | Any tissue bank. | Yes. | Any tissue bank. | Yes. |
| Data Validation Level | Compare values for same species & size across province. | Data validity assessed from analytical duplicates, blanks, reference materials, or matrix spiked samples. Also, values are compared to each other for same species and size at same site. | Compare values together for same species and size at same site. | Performed at two levels: a routine lab report and a less frequent complete data validation. |

**Section V: Data Presentation**

| Wet Weight | Connecticut | Maine | Massachusetts | New Hampshire | Vermont | | Wet Weight | New Brunswick | Nova Scotia | Québec | U.S. EPA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Wet/Dry Weight | Data reported in wet weight. | Wet | Data has been reported on a wet weight basis. | Except for REMAP study, all data wet weight. | All Hg concentrations are presented as mg/l, wet weight. | | Wet/Dry Weight | Yes (?) | Data reported in wet weight. | Only wet weight used. | Depends. |

**Section VI: Data Storage & Measure of Accessibility**

| Database | Connecticut | Maine | Massachusetts | New Hampshire | Vermont | | Database | New Brunswick | Nova Scotia | Québec | U.S. EPA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Database Format | MS ACCESS. | MS EXCEL. Will go to central database and then STORET. | MS EXCEL. | DPHS uses MS EXCEL, DES uses FOXPRO. | MS ACCESS. | | Database Format | | Majority of data available in MS EXCEL format. | MS EXCEL. | Kept either in hardcopy or as a database by project lead. Eventually will be stored in national database in STORET or EDAS. |
| Hardcopy/Format & Accessibility | Several reports available in hardcopy. | At DEP website (http://janus.state.me.us/dep/blwq/monitoring.htm) | Older data available in hardcopy only. | Data back through 1994 available upon request. | Accessible to public (contact Rich Langdon, VT DEC). | | Hardcopy/Format & Accessibility | Yes, upon request. | A number of reports are available from the NSAF. | By request. | Once reviewed, all reports are available to the public. |
| Document Availability (Contact Info) | Reports available by contacting DEP. | Limited number of annual data reports available. | DEP and DPH document list available. | Currently available by request, but in future accessible through STORETS. | | | Document Availability (Contact Info) | Available in brochure format. | Reports available by contacting NSAF at 902-485-7023. | Documents available at website: http://www.menv.gouv.qc.ca/eau/guide/index.htm | |
| Further Information: Contact Person | Tess Gutowski, CT DEP, at 860-424-3096. | Barry Mower Me DEP 207-287-7777 | | | | | Further Information: Contact Person | | John MacMillan: 902-485-7023. Darrell Taylor: 902-424-2570. | | |